CHAPTER I

INTRODUCTION
1.1 Introduction

The small and medium enterprises are widely regarded as the engine of the Indian economy. Small and medium enterprises (SMEs) contribute significantly to industrial, economic, technological and regional development in all developed and developing countries. The SME sector is playing significant role in the development of entrepreneurial skills and forms a substantial portion of the country's export earnings.

Small and medium enterprises (SMEs) abilities are employment generation, technological innovation, promoting inter-sectoral linkages, raising exports and developing entrepreneurial skills. With location flexibility SME's are reducing to regional imbalances. The future of SMEs is of major policy concern given the strategic importance in reshaping the industrial sector. This culture is evident in India also, which has one of the longest histories of Government support to the small-scale industrial sector since independence compared with that of the most developing countries.

1.2 Overview of the MSME Sector in India

In 1956, with the promulgation of the second industrial policy, the Government laid the foundation of a policy framework for the small scale industry. The Government realised that small scale industries would generate immediate large scale employment in the country.

In the Indian context, there is no demarking exist clearly among Small and Medium Enterprises till 1997. During 1997, on the recommendation of Abid Hussain Committee, the Government has raised the investment limit on plant and machinery for small units and ancillaries from Rs60/75 lakhs to 3Crores. Again Government of India in 2000 has reduced the investment limit on plant and machinery from 3crores to Rs. 1Crore in small scale Industries.

In India, the enterprises have been classified broadly into two categories

i) Manufacturing; and

ii) Services.
Both categories have been further classified into micro, small and medium enterprises (MSME) based on their investment in plant and machinery or on equipment. With effect from October 2, 2006, according to MSME Development Act the investment limit in Plant & Machinery for micro enterprises is less than Rs.25Lakhs; for Small enterprises the investment limit is between Rs.25lakhs and Rs.5Crores and for Medium enterprises the investment limit is between Rs.5Crores and Rs. 10Crore. Table 1.1 shows the present ceiling of investment to be classified as micro, small or medium enterprises is as under:

### Table 1.1: Classification of Micro Small and Medium Enterprises

<table>
<thead>
<tr>
<th>Classification</th>
<th>Investment ceiling for plant, Machinery or Equipments</th>
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<tbody>
<tr>
<td></td>
<td>Manufacturing Enterprises</td>
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<tr>
<td>Micro</td>
<td>Upto Rs. 25 lakh</td>
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<tr>
<td>Small</td>
<td>Above Rs. 25 lakh &amp; upto Rs. 5 crore</td>
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<td>Medium</td>
<td>Above Rs. 5 Crore &amp; upto Rs. 10 crore</td>
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Maximum opportunities are provided by the MSME sector for both self-employment and jobs and agriculture sector. According to the 4th Census 595lakh persons were employed by 261lakh enterprises. During the fiscal year of 2008-09, 659lakh are employed by 285lakh enterprises. The percentage growth rate of the number of MSMEs from 2008 to 2009 was found to be 4.53%. An increase in employment growth rate of 5.35% was observed in 2009 compared to the previous year. It was estimated that through the fiscal year of 2009-2010, in over 26 million units throughout the country, about 59 million people were employed in the MSME sector. The highest growth rate was observed in the MSME sector than that of the industrial sector. There has still been a rise in the development of MSME sector in India. The MSMEs in India are involved in manufacture about 6000 products that range from traditional goods to high-tech items. The contribution of goods in MSME sector includes 22% from food products, 12% from chemical products, 10% from basic metal industry, 8% from metal products, 6% from electrical machinery parts, 6% from rubber plastic products, and 36% from other products.
SMEs have been established in almost all-major sectors in the Indian industry, some of them are: Food processing, Agricultural inputs, Chemicals & Pharmaceuticals, Engineering, Electrical, Electronics, Electro – medical equipment, Textiles & garments, Leather and leather goods, Meat products, Bio-engineering, Sports goods, Plastic products and Computer software.

1.3 The Importance of SMEs

SMEs are corner stones in the industrial structure. They not only directly provide a major part of manufactured output but also they are the essential seeds from which larger business grow as well (Johansson, 2002) [1]. Johansson also states that SMEs are not usually a major source of economic trade but contribute as suppliers to larger, multinational companies. Further, new small companies function as seedbeds from which larger export oriented domestic companies grow and emerge. But in Swedish, according to Nutek (1995) [2] only a tiny part of the Swedish companies grow, and the preconditions can be viewed from three different perspectives: the ability, the possibility and the desire to grow. In the long run the companies’ ability to compete is determined by applying new technology, new products and enhancement of existing products and use of the employee’s competence (Nutek, 1995) [2].

1.4 Development of SMEs

SMEs develop in a manner, which made it possible for them to achieve the following objectives.

- High contribution to domestic production
- Significant export earnings
- Low investment requirements
- Operational flexibility
- Location wise mobility
- Low intensive imports
- Capacities to develop appropriate indigenous technology
- Import substitution
- Contribution towards defence production
- Technology – oriented industries
- Competitiveness in domestic and export markets.
1.5 **Challenges Faced by Indian SMEs**

Increasing competition and globalization, along with the need to produce quality products and process or services at best prices, have prompted the industry to introduce new product and process development methods with modern technology. The need to evolve technologically superior methods of product development holds true, especially for players in the SME segment.

Indian SMEs have been exposed to intense competition due to increasing globalization. This has made difficult for survival and growth of this sector. Some of the challenges faced by Indian SMEs are: availability of infrastructure development to SMEs, new product and process development, technology development, lack of information and new market trends, lack of finance, lack of planning, lack of right staff.

1.5.1 **Availability Infrastructure development to SMEs**

The quality of the infrastructure affects the growth and prospects of SMEs to a great extent, especially in a developing country like India. Here 77% of the population lives in villages. Many rural areas still suffer due to the deplorable state of basic infrastructure like transport, telecommunications and electricity. The integration of rural industries with mainstream industries is proving to be difficult for these reasons. This, in fact, has been identified as a key deterrent to the growth of SME clusters in rural areas.

1.5.2 **New product and process development**

The SME market requires a strong new product and process base. In India, most SMEs work on the designs given to them by domestic or foreign buyers. There is very little innovation in product design development, and even the technology used by the SMEs in India is outdated.

This has a direct implication on the profit margins, and productivity levels. The use of traditional tools, techniques, poor labour productivity and infrastructure bottlenecks, in some of the product lines are additional reasons for the stunted growth of SMEs. Though innovative methods have been developed to increase productivity,
they have not been used to a large extent, resulting in no substantial effect on the output.

1.5.3 Affordability of Technology development

Technology plays a crucial role in the development of SMEs. Technology not only helps in evolving a multi-pronged strategy but also in maximising business opportunities for these enterprises. Technologies for SMEs should aim at fuelling innovation and business agility. They should be easy to integrate with existing systems and processes, and help in leveraging communication and information management. Today, most SMEs in rural areas undertake manufacturing using old methods and outdated technology. But today, the competition is fierce, unlike in the past, when buyers were simply looked forward to purchasing the best products at the lowest prices. There are additional challenges to be met. The influx of low-cost products from China has made it even more difficult for Indian manufacturers to compete solely on the price front. China is considered the world's manufacturing backyard, due to its low manufacturing and labour costs when compared to those in India.

1.5.4 Lack of information and new market trends

One of the factors limiting the growth of SMEs is the lack of adequate information. Once SMEs start the business, they may be interested in knowing about the suppliers of specific machinery that suit their needs, technical information and market needs for their products. This information is rarely available at the grassroot level.

1.5.5 Lack of Finance

Lack of finance has emerged as the most critical barrier for perfect capacity utilization and competing in the market. SMEs are not able to raise adequate funds from banks, especially for high risk projects. Insufficient basic infrastructure facilities like irregular power and water supply, bad road and railway connectivity etc are some of the factors that are hampering the growth of SMEs in India.
1.5.6 Lack of Planning

Another problem that is mainly faced by SME sector is the proper division of time and resources which are usually the outcome of improper planning and strategy. Moreover, if enterprises are in debt then it has to be careful from their bankers and suppliers and of course their employees who will be on its nerves on the salary day.

1.5.7 Lack of Right Staff

SMEs are largely dependent on their staff, if they fail in the recruitment process, they fail indeed. SMEs must hire right employees, who contribute their best and support the enterprise through their performances.

There is a strong need to find ways to manage modern technology and labour market constraints, which impede the productivity of SMEs. Policy-makers and research institutions have repeatedly pointed out to the need for extensive research on the SME sector. What these SMEs primarily need today is knowledge and access to new technology; adequate financial aid, high levels of R&D and adaptability to the changing trends in their respective industries.

From the above discussion it is clear that, those SMEs who have strong technological base, international business outlook, competitive spirit and willingness to restructure themselves shall withstand the present challenges and come out with shining colors’ to make their own contribution to the Indian economy.

1.6 Problems of SMEs in India

The following problems are facing by Indian SMEs

1.6.1 Poor Awareness About IPR
1.6.2 Problem of Specialised Training
1.6.3 Problem of Skilled Management
1.6.4 Low Quality of Input
1.6.5 Less Innovative Actions in SMEs
1.6.6 Lack of Proper Market Information
1.6.7 Research and Development
1.6.1 Poor Awareness about IPR

In the changing global scenario, the issues of IPR have gained special importance for the Micro, Small & Medium Enterprise (MSME) sector. Protection plays a key role in gaining competitive advantage in terms of technological gains for achieving higher economic growth in a market driven economy. It is felt that IPR requires greater understanding and attention by the industry, particularly the MSME sector in India. The Indian MSME sector needs more information, orientation and facilities protecting their intellectual powers. While majority of the countries have adopted strategies for implementing strong IPR protection for strengthening their industries and trades. But Indian industries, particularly the MSME are lagging behind in recognizing the importance of IPR and adopting IPR as a business strategy for enhancing competitiveness.

1.6.2 Problem of Specialised Training

In a present global scenario there is an urgent need for creating skilled human resources so as to build capacity and develop the SMEs sector that is compatible with commercialization requirements. To achieve the objective there is need to conduct training programmes for enhancement of knowledge and capacity building of SMEs sector in all fields of Intellectual Property.

1.6.3 Problem of Skilled Management

In a market with low entrance barriers, trained apprentices usually lead the enterprise to start their own. Management constraints include inter alias the lack of skills in basic business management, accounting, book keeping and the lack of accessible consulting and support services. In addition, with a relatively low of educational attainment only 9% small and micro entrepreneurs have university degrees.
1.6.4 Low Quality of Input

High-quality production inputs are not easily available to SMEs. In order to obtain these inputs, SMEs can’t compete with export oriented big industrial houses as well as Multi National Companies. Larger firm acquiring all high quality input raw material in the domestic market to their bargaining power but SMEs can’t acquire that input to produce better quality output. In addition, the government has imposed tariffs on high quality imported inputs it affecting on compatibility of SMEs in India.

1.6.5 Less Innovative Actions in SMEs

Innovation is the means by which the entrepreneur either creates new wealth producing resources or endows existing resources which enhanced potential for creating wealth. There is a need for Product innovation, Process innovation and Organizational innovation. There is a need for creative development and commercialization of new products or services radically using new technology in order to meet unmet customer requirements. Development of new ways of producing or delivering services leads to cost efficiencies or speedier deliveries.

1.6.6 Lack of Proper Market Information

Information about market is the core factor of any business activity. But it is an essential part of marketing strategy. According to the survey of Ministry of Small Scale Industries, nearly two-thirds of small business considers the lack of market information, lack the capacity, and their owners lack the education to tap sources of relevant information about new products, consumer trends technological developments etc.

1.6.7 Research and Development

Another hurdle faced by the SMEs is low level of research and development (R&D). R&D is most important requirement of the ice units in the era of globalized market. But the current understanding of R&D activities of SMEs is much lesser than the understanding of similar activities of larger multinational enterprises. Such are still falling down on R&D due to weak links between business and academic research.
1.6.8 Lack of Awareness of Global Trade Laws

The other barriers in the path of SMEs are lack of information, capability to build up an international market position and maintaining international business relations and unsatisfactory management skills. Most enterprises in this sector are more product and technology oriented than market oriented. Moreover the lack of managers with international experience global trade laws and foreign language skills are another barrier in the growth.

1.6.9 Reduction in Export Subsidies

The emerging challenges to the small-scale sector are to come from the impact of the Agreements under WTO. This is expected to lead to an expansion in the volume of international trade and changes in the path of commodity flows. The main outcomes of WTO stipulated requirements will be brought through reduction in export subsidies, greater marker access, removal of non-tariff barriers and reduction in tariffs. Increased market access under WTO requirements will also mean that industries can compete for export markets in both developed and developing countries as well as big and small scale industries.

1.6.10 Low Level of ICT Adoption in SMEs

ICT adoption by the Indian SMEs is extremely low. As per the Governments estimates the ICT adoption among small business firms in India is less than 30%, and if the ICT firms in the SME segment are not considered the number will be significantly less. The main reason for low adoption are; the first generation small firm owners are not technology savvy and are extremely uneasy to adopt new technology. Many clusters are local in semi-urban areas or rural areas and therefore, cannot avail of the communication bring in. The small firms of India have significantly less funds compared to their competitors and therefore, they cannot adopt ICT in SMEs.

All above problems of SMEs in India are affecting on progress of SMEs. But this sector is an important sector in the Indian economy because an instrument of poverty and unemployment abolition. Hence there is need for support and encouragement to Indian SMEs.
1.7 Important Schemes of Ministry of MSME

To develop the SME sector Government of India, ministry of MSME brought some important schemes are as follows.

1.7.1 Credit Guarantee Scheme

1.7.2 ISO 9000/14001 Certification Fee Reimbursement Scheme

1.7.3 Micro & Small Enterprises Cluster Development Program

1.7.4 Credit Linked Capital Subsidy Scheme

1.7.5 Intellectual Property Rights for MSMEs

1.7.6 Incubator Scheme

1.7.7 Quality Management Standards/Quality Technology Tools

1.7.8 Mini Tool Room

1.7.9 Marketing Assistance (Bar Code)

1.7.10 Lean Manufacturing Competitiveness program

1.7.11 Technology Up gradation

1.7.12 Skill Development

1.7.13 Marketing & Procurement

1.7.14 Export Promotion

1.7.15 Infrastructural Development

1.7.16 National Awards

1.7.17 Rajiv Gandhi Udyami Mitra Yojna (RGUMY)

1.7.1 Credit Guarantee Scheme: To ensure better flow of credit to micro and small enterprises by minimizing the risk perception of banks/financial institutions in lending without collateral security, the Government launched Credit Guarantee Fund Scheme for MSMEs in August 2000. This scheme covers collateral-free credit facility extended by eligible lending institutions to new and existing MSEs for loan up to Rs.100 laky per borrowing unit. The Guarantee cover is up to 75% of the credit sanctioned.
1.7.2 **ISO 9000/14001 Certification Fee Reimbursement Scheme:** To enhance the competitive strength of the MSMEs, the Government introduced a scheme to incentivize technological upgradation, quality improvement and better environment management by the MSMEs. The scheme reimburses 75% of the fees, subject to a maximum of Rs.75,000/- for acquiring Quality Management System (QMS)/ISO 9000 certification and/or Environment management (EMS)/ISO 14001 certification by the MSMEs.

1.7.3 **MSE Cluster Development Programme:** The Micro and Small Enterprises Cluster Development Programme (MSE CDP) is implemented for holistic development of clusters of MSEs. The programme envisages measures for capacity, skill development, technology upgradation of the enterprises, improved credit delivery, marketing support, setting up of common facility centers etc, based on diagnostic studies carried out in consultation with cluster units and their collectives and management of cluster-wide facilities by the cluster collectives.

1.7.4 **Credit Linked Capital Subsidy Scheme:** The credit linked capital subsidy aims at facilitating technology up-gradation by providing 15% upfront capital subsidy W.E.F. 29th September, 2005 to manufacturing MSMEs, on institutional finance up to Rs. 1 crore availed of by them for induction of well-established and improved technologies in the specified sub-sectors/products approved under the scheme.

1.7.5 **Intellectual Property Rights in MSMEs:** This scheme has been launched to enable Indian MSMEs to attain global leadership position and to empower them in using effectively the tools of Intellectual Property Rights of innovative projects. The main features of the scheme are

i. Awareness/Sensitization Program on IPR

ii. Pilot Studies for selected clusters/groups of industries

iii. Interactive seminars/workshops

iv. Specialized training
v Assistance for grant of patent/GI registration
vi Setting up of IP Facilitation Centre (IPFC)
vii Interaction with International Agencies.
viii These initiatives are being developed through public-private partnership mode.

1.7.6 Entrepreneurial and Managerial Development of SMEs through incubators: The scheme aims at nurturing innovative business ideas which could be commercialized in a year. Under the scheme, various institutions like Engineering Colleges, Research labs etc will be provided funds up to Rs. 6.25 lakh for handholding each new idea/entrepreneur. The incubator will provide technology guidance, workshop and lab support and linkage to other agencies for successful launching of the establishing and guide the entrepreneur in establishing the enterprise.

1.7.7 Quality Management Standards & Quality Technology Tools: Government of India launched a scheme enabling management sector be competitive through quality management standards (QMS) and quality technology tools (QTT) in order to improve quality and productivity in the MSME sector. The scheme is aimed at improving the quality of the products in the MSME sector and inculcates the quality consciousness in this sector. The major activities under the scheme are
i Introduction of appropriate modules for technical institutions
ii Organizing awareness campaigns for MSMEs
iii Organizing competition-watch
iv Implementation of quality management standards and quality technology tools in selected MSMEs
v Monitoring international study missions
vi Impact studies of the initiatives
1.7.8 **Mini Tool Room:** Under the scheme competitive bidding from entrepreneurs and associations will be invited to set up tool rooms with Government support up to Rs. 9 core. They will be more competitive and user friendly as they are bound by the Government procedure and competitiveness are only the criteria for selection of promoters of these tool rooms. The approved plan expenditure under the scheme is Rs. 135 crore.

1.7.9 **Marketing Assistance/Support to MSMEs (Bar Code):** The objective of this scheme is to popularize the bar code registration and motivate the micro small medium manufacturing enterprises to adopt the bar code certification on large scale and to sell their value added products worldwide and enable higher export price realization. It also helps in domestic marketing. Seventy five percent of the annual fees of bar code certification for the first three years are reimbursed to MSMEs under the scheme.

1.7.10 **Lean Manufacturing Competitiveness Program (LMP) for MSMEs:** Under this scheme MSMEs are assisted in reducing their manufacturing costs, through proper personnel management, improved process flows, reduce engineering time and so on. LMP also brings improvement in the quality of products and lowers costs which are essential for competing in national and international markets. The total Government of India (GOI) contribution is stipulated as Rs. 28.60 crore for this scheme, the broad activities planned under the scheme include total productive maintenance, 5s, visual control, standard operation procedures, just in time, kanban system, cellular layout, poka yoke and TPM. The scheme has been approved as a pilot project for lean techniques interventions in 100 mini clusters.

1.7.11 **Marketing Assistance and Technology Upgradation Scheme for MSMEs:** The objective of this scheme is to identify and encourage those clusters of MSMEs which have quality production and export potential and assist them to achieve competitiveness in the national and international markets. The scheme aims at improving the marketing competitiveness of MSME sector by improving their techniques and technology for promotion of exports. The Government of India (GOI) contribution is stipulated as Rs. 19 crore for this scheme. The broad activities planned under the scheme include technology up
gradation in packaging, development of modern marketing techniques and competition studies.

1.7.12 Skill Development: With an objective to create self employment, the entrepreneurship and skill development scheme is implemented by office of the DC (MSME) through its network of 59 MSME-DIS and their branches. The program are conducted include entrepreneurship development, entrepreneurship and skill development, management development and business skill development. These programs are conducted for unemployed youth against a nominal fee and in some cases stipend is also provided.

1.7.13 Marketing and Procurement: Under Government stores purchase program, various facilities are provided to enterprises registered with National Small Industries Corporation (NSIC) in order to assist them for marketing their products in competitive environment. These facilities are

i. Issue of tender sets free of cost

ii. Exemption from payment of Earnest money deposit

iii. Waiver of security deposit up to the monetary limit for which the unit is registered

iv. Price preference up to 15% over the quotation of large scale unit.

In addition theses items have been reserved for exclusive purchase from MSME sector.

1.7.14 Export Promotion: Export promotion from the MSME sector has been accorded a high priority. To help MSMEs in exporting their products, the following facilities/incentives are provided

i. Products of MSME exporters are displayed in international exhibition and the expenditure incurred is reimbursed by the Government.

ii. To acquaint MSME exporters with latest packaging for exporters are organized in various parts of the country in association with the Indian Institute of Packaging.

iii. Under the MSME Marketing Development Assistance (MDA) scheme, assistance is provided to individuals for participation in overseas fairs/exhibitions, overseas study tours.
The scheme also offers assistance for

a. Sector specific market study by MSME Associating/ Export promotion councils/Federation of Indian Export Organization.

b. Initiating/ contesting anti dumping cases by MSME Associations and
c. Reimbursement of 75% of the one time registration fee and annual fee charged by GSI India for adoption of Bar Coding.

1.7.15 Infrastructure Development: For setting up of industrial estates and to develop infrastructure facilities like power distribution network, water, telecommunication, drainage and pollution control facilities, roads, banks, raw material, storage and marketing outlets, common service facilities and technological back up services for MSMEs, the Integrated Infrastructural Development scheme was launched in 1994. The scheme covers rural as well as urban areas with a provision of 50% reservation for rural area and 50% industrial plots are to be reserved for the micro enterprises. The scheme also provides upgradation/strengthening of the infrastructural facilities in the existing industrial estates. The estimated cost to set up an IID centre is Rs. 5 core. Central Government provided 40% in case of general states and up to 80% for north east region, J&K, H.P. and Uttrakhand as grant and remaining amount is borrowing loan from SIDBI/Bank/Financial Institutions or the state funds.

1.7.16 National Awards: Details of national awards under category (A) are as follows

a. National awards for outstanding entrepreneurship in micro & small enterprises in manufacturing:
   i  First national award: Rs. 1,00,000/- cash prize, a trophy and a certificate.
   ii Second national award: Rs.75,000/- cash prize, a trophy and a certificate.
   iii Third national award: Rs.50,000/- cash prize, a trophy and a certificate.
   iv Special national award to outstanding women entrepreneur: Rs.1,00,000/- cash prize, a trophy and a certificate.
   v Special national award to outstanding SC/ST entrepreneur: Rs.1,00,000/- cash prize, a trophy and a certificate.
vi Special national award to outstanding entrepreneur from NER including Sikkim; Rs.1,00,000/- cash prize, a trophy and a certificate.

b. National awards for outstanding entrepreneurship in micro & small enterprises in services:
   i First national award: Rs. 1,00,000/- cash prize, a trophy and a certificate.
   ii Second national award: Rs. 75,000/- cash prize, a trophy and a certificate.

c. National awards for outstanding entrepreneurship in Medium enterprises engaged in manufacturing:
   i First national award: Rs.1,00,000/- cash prize, a trophy and a certificate.
   ii Second national award: Rs.75,000/- cash prize, a trophy and a certificate.

d. National awards for outstanding entrepreneurship in Medium enterprises engaged in services:
   i First national award: Rs.1,00,000/- cash prize, a trophy and a certificate.
   ii Second national award: Rs.75,000/- cash prize, a trophy and a certificate.

1.7.17 Rajiv Gandhi Udhyami Mitra: Rajiv Gandhi Udhyami Mitra Yojna (RGUMY) is to provide handholding support and assistance to the potential first generation entrepreneurs who have already successfully completed EDP/SDP/ESDP/VT programs, through the selected lead agencies i.e ‘Udyami Mitra’ in the establishment and management of the new enterprises in dealing with various procedural and legal hurdles and in completion of various formalities required for setting up and running of the enterprise.

Under RGUMY, financial assistance would be provided to the selected lead agencies i.e. udyami mitras for rendering assistance and handholding support to the potential first generation entrepreneurs.

1.8 Areas of cooperation: Indian MSME

Initially, India had benefitted from the experience of several countries especially in the field of technology. However, the rich Indian experience gained in the last sixty years in the MSME sector was an equal use for both developing as well
as developed countries. Some of the areas that offer ample opportunities for cooperation in the MSME sector are:

i) Consultancy services and training in the following areas:
   a. Capacity Building of Entrepreneurs and Technical Manpower of SMEs
   b. Policy & Institutional Framework for SME Promotion, Development and Enhancing Competitiveness;
   c. Entrepreneurship Development; and
   d. Business Development Services

ii) Establishment of Turnkey Projects for setting up manufacturing MSME on commercial terms.

iii) Skill upgradation programmes in selected areas such as CNC Machining, Sheet-Metal Technologies, CAD & CAM Designing, Wool Processing & Weaving, Leather Technology, Plastic Technology and Wood Working.

iv) Conducting surveys and studies to identify the tooling and related skill requirements in specific areas or regions like hilly/backward/indigenous.

v) Providing Turnkey assistance to set up Tool Room & Training Centres.

vi) High precision tools, moulds, die jigs and fixtures as per design/specifications of local industry.

vii) Product development & rapid prototyping services.

viii) Providing consultancy to existing training institutes in course design and curriculum development including train the trainer programmes.

ix) Providing consultancy to existing manufacturing SME in upgrading their production facilities, selection of machine tools, design consultancy for tools, moulds, dies, jigs and fixtures.

x) Providing specialized/tailor-made training courses for specific target groups.

xi) Assistance in product design, tool design and manufacturing of intricate tooling.

1.9 Innovation

The ability to innovate is a vital core competency one that entrepreneur, manager or leader must possess, in order to build growing, profitable businesses. At the same time innovation is one of the most difficult processes that should guide and shape. Innovation is a combination of high risk and high returns. The ultimate goal of
Innovation is sustained competitive advantage. Sustained competitive advantage necessarily requires sustained innovation. To bring an innovation to market, companies conceive an invention and create inventions become innovations when they are refined in a manner and bring them successfully to market.

1.10 The phenomenon of Innovation

Over the years, the subject of innovation has been studied from two broad perspectives. The first, an economics-oriented tradition, examines differences in the pattern of innovation across countries and industrial sectors, the evolution of technologies and inter-sectoral differences in innovation (e.g. Rosenberg, 1982; Dosi et al., 1988; Nelson, 1993; Niosi, 1995). The second, management-oriented tradition focuses on the micro- and meso-level and how new products are developed. These studies differ with respect to the sector studied, the level of aggregation (individuals, projects, firms or inter-firm innovation), the size or type of company (high-tech startups, large conglomerates), the scope (incremental or radical, disruptive or sustaining innovations) or type of innovations studied (product, process or organizational innovations) and the geographical setting.

The popularity and wide applicability of the word ‘innovation’ has resulted in a proliferation of its meanings. The broad definition of innovation as provided by Schumpeter (1934): The introduction of a new good -that is one with which consumers are not yet familiar- or of a new quality of a good. 2) The introduction of a new method of production, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially. 3) The opening of a new market that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before. 4) The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created. 5) The carrying out of the new organization of any industry, like the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position.

This definition implies that innovation means more than just the creation of new products, processes and services and may also include innovation of business
models, management techniques and strategies and organizational structures (Hamel and Prahalad, 1994). Innovation typically involves creativity but is not identical to it: innovation involves acting on creative ideas to make some specific and tangible difference in the domain in which the innovation occurs. For example, as Amabile (1996) stated: Creativity by individuals and teams is a starting point for innovation; the first is necessary but not sufficient condition for the second. It is important to note that innovation is not the same as invention. In general, an invention refers to the result of research activities (e.g. a patent), while an innovation is a commercial product, process or service. Martin (1985) describes it as follows: An invention may be viewed as a new idea or concept, but this invention only becomes an innovation when it is transformed into a socially usable product.

The word innovation comes from the Latin word "Innovare" which means to "make new". Innovations involve new methods of doing things and are associated with risks, failure, new ways of management thinking and unlearning of old ways. Innovation is the process of doing new things. It is important to recognize that innovation implies action, not just conceiving of new ideas.

1.1 Definitions of Innovations

Schumpeter (1934), essentially the most significant character within the innovation literature, defines product innovations as "the creation of a new good which more adequately satisfies existing and previously satisfied needs." Schumpeter (1939) identifies, supposed commercial risks constitute potential profits for the investor.

In addition, some authors distinguish innovation as ideas of new inventions. Rogers and Shoemaker (1971) defined that it is about 'new' in the context of innovation, the idea seems new and different for personal.

Utterback and Abernathy (1975) define a product innovation as "a new technology or combination of technologies introduced commercially to meet a user or market need. "Even though their perspective implies limitedly a 'technological innovation,' according to them, "technological innovations which may have market application, lie fallow until markets can be identified or created." They argue,
product innovation tends to be driven or stimulated by new market needs and opportunities” (Utterback and Abernathy, 1975)\[13].

Freeman (1982)\[14], in one of the most significant post-Schumpeterian studies on the theory of innovation, defines ‘innovation’ as including “....technical, design, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment”.

Others think it is important for company, such as Porter (1990)\[15] and Branson (1998)\[16], consider innovation is a way to achieve competitive advantage, it is a good idea to motivate employees and to understand what your customers need.

Innovation is the sequence of activities by which a new element is introduced into a social unit, with the intention of benefitting the unit, some part of it, or the wider society. The elements need not be entirely novel or unfamiliar to members of the unit, but it must involve some discernible change or challenge of the status quo-Michael A. West and James L. Parr (1990)\[17].

OECD (1992)\[18] brings a distinction between a ‘technological innovation’ and ‘product innovation’ due to the implementation of the technological novelty to a product or service and the marketability quality of a product or service. As per OECD (1992)\[18], “Technological innovations comprise new products and processes and significant technological changes of products and processes. An innovation has been implemented if it has been introduced on the market (product innovation).”

Known to be used etymologically well after the term ‘invention’, according to the product Development Management Association, the act of ‘innovation’ includes invention as well as the work required to bring an idea or concept into final form’ (Rosenau, 1996)\[19]. In the everyday language, ‘innovation’ is recognized as a synonym for ‘invention’, which means ‘a new device or process created by study and experimentation’ (Worldnet, 1997)\[20].

Leonard and Swap (1999)\[21] study ‘innovation’ in connection with ‘creativity.’ Innovation is the end result of a creative activity. Within this framework, they define ‘creativity’ as “.....a process of developing and expressing novel ideas that
are likely to be useful" (Leanord and Swap, 1999) [21]. Such a definition emphasizes not only the new, novel and unusual, but also 'useful' characteristics of the 'creative activity', which leads to the potential for utility. From this perspective, as the end result of the creative process, "innovation is the embodiment, combination, and/or synthesis of knowledge in novel, relevant, valued new product, processes or services" (Leonard and Swap, 1999)[21].

Contemporary marketing literature identifies innovations from the standpoint of the 'investor' in a way that is similar to that of Schumpeter. Cooper (2000) [22] mentions that an innovation relies on the notion of commercial risk. According to him, any change of the product that is perceived by the consumer, and therefore creates risk to the brand, business, or franchise, is considered an innovation. Consequently, as

According to Tidd et al. (2001) [23], "innovation is more than simply coming up with good ideas; it is the process of growing them into practical use". They expose invention as "only the first step in a long process of bringing a good idea to widespread and effective use" (Tidd et al., 2001)[23].

Sethi et al. (2001) [24] associate 'innovation' with a "meaningful uniqueness" in new products. According to them, the degree of innovation in a new product is "the extent to which to which a new product provides meaningfully unique benefits."

Meanwhile, innovation is a mindset, an attitude, or a way of thinking focused beyond the present into the future vision (Kuczmarski 2003) [25]. According to the Kuczmarski (2003) [25], innovation should be a process, a strategy, benchmark, a cross-functional team or a new-to-the world process. Through that, the company has developed a mindset that impacts every aspects of its business. The view is stated that effective innovation is a key to gain competitiveness.

Innovation, according to Rogers (2003) [26], is "an idea, a practice, or an object that is perceived as new by an individual or other unit of adoption". This "newness" need not necessarily involve "new" knowledge thereby effectively implying that the "newness" may also concern advancement or modification of existing knowledge.
They regard innovation as invention and commercialization of new (or betterment of existing) products, process and/or services.

Innovation is the management about activities involved in the process of idea generation, technology development, manufacturing and marketing of a new product, manufacturing process or equipment-Trott (2005)\textsuperscript{[27]}

Innovation has been regarded as a kind of strategy, it is also as an ability to create and develop the market and the competitiveness of companies, strategic innovation is concerned with developing the entire company (Drejer 2006)\textsuperscript{[28]}.

Innovation as the process of translation new ideas into useful practice and use them, like new products, processes and services-Bessant and Tidd (2007)\textsuperscript{[29]}.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schumpeter</td>
<td>1934</td>
<td>“The creation of a new good which more adequately satisfies existing and previously satisfied needs.”</td>
</tr>
<tr>
<td>Schumpeter</td>
<td>1939</td>
<td>Innovation as supposed commercial risks constitutes potential profits for the investor</td>
</tr>
<tr>
<td>Utterback and</td>
<td>1975</td>
<td>Product innovation as “a new technology or combination of technologies introduced commercially to meet a user or market need. “Even though their perspective implies limitedly a ‘technological innovation,’ according to them, “Technological innovations which may have market application, lie fallow until markets can be identified or created.”</td>
</tr>
<tr>
<td>Abernathy</td>
<td></td>
<td></td>
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<tr>
<td>Freeman</td>
<td>1982</td>
<td>‘Innovation’ as including “....technical, design, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment”.</td>
</tr>
<tr>
<td>Porter and</td>
<td>1990</td>
<td></td>
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<tr>
<td>Branson</td>
<td>1998</td>
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<tr>
<td>Author</td>
<td>Year</td>
<td>Definitions</td>
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<td>Michael A. West</td>
<td>1990</td>
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<tr>
<td>Rosenau</td>
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<td>Leonard and Swap</td>
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<tr>
<td>Sethi et al</td>
<td>2001</td>
<td>• The degree of innovation in a new product is &quot;the extent to which a new product provides meaningfully unique benefits.&quot;</td>
</tr>
<tr>
<td>Kuczmarcki</td>
<td>2003</td>
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<tr>
<td>Rogers</td>
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</tr>
<tr>
<td>Trott</td>
<td>2005</td>
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</tr>
<tr>
<td>Drejer</td>
<td>2006</td>
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</tr>
<tr>
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<td>2007</td>
<td>• Innovation as the process of translation new ideas into useful practice and use them, like new products, processes and services.</td>
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</tbody>
</table>
1.12 Theory of Innovation

The theory of innovation dates back to early studies on the capital system. It was Bacon, at the beginning of the 17th century, who suggested a 'science-created utopia' on the role of the developments in science and technology in society. His views were opposed by Bernal of his generation, who gave importance on the uses of new discoveries for societal wealth rather than their own creation. Later, Adam Smith, in the second half of the 18th century, suggested technological change as a major concern for the development of industrial production. In the first half of the 19th century, Marx put forward the view that technological advancements – and improved industrial production – had displaced the 'worker', causing confusion in the social order. Lately, it was Schumpeter, in the first half of the 20th century, who first mentioned ‘innovation’ as “keeping the capitalist engine in motion.” Schumpeter suggested innovations to be imperative for economic growth, commercial profit, and thus, public wealth. Schumpeter's theory has later been developed by neo-Schumpeterian economists such as Freeman and Dosi. Recently, contributions from diverse disciplines including Design, Management, and Marketing have developed the modern theory of innovation (Smith, 1776[30]; Marshall, 1930[31]; Schumpeter, 1934[17], 1939[11], 1942[32], 1954b[33]; Meier and Baldwin, 1957[34]; Freeman, 1982[14], 1990[35]; Elliot, 1985[36]; Sylwestor, 2000[37]).

During the course of the development of the theory of innovation, scholars with different approaches including the classical economists, the Marxists, the neoclassical theorists, the Schumpeterians, post-Keynesians, and post-Schumpeterians have had significant contributions. Nevertheless, two characters in the history of innovation emerge; Adam Smith by laying the foundations of the classical understanding of technical change and economic growth and Joseph Schumpeter by challenging Smith’s views with a dynamic theory of economics based on cycles of innovation.

Smith (1776) [30] was fundamentally the first classical economist to study technical change and its impact on economic growth. He believes that economic development is a gradual, self-perpetuating process. He builds his theory on the eighteenth-century doctrine of natural law. He asserts that, within the control of the
natural legal system, each member of the society is free to pursue his self-interest, resulting in a harmonious, beneficial economic order. According to him, development has a tendency to become cumulative, which results in an increase in saved capital. Smith describes it as 'Capital Accumulation', which is a fundamental element in economic development and an increase in the extent of the market-that will eventually result in an increase in national income and growth in population (original Source, Smith, 1776[30], quoted from Meier and Baldwin, 1957[34]). Smith's classical theory mentions developments to resulting in “improvements in art,” which will lead to further specialization and productivity gains (Meier and Baldwin, 1957)[34].

Schumpeterian analysis brings an outstanding point of view to Smith's classical theory, providing the most comprehensive and provocative analysis since Marx of the economic development and social transformation of industrializing capitalism (Elliot, 1985) [36]. Schumpeter (1934[17], 1939[11], 1942[32], 1954a [38] and 1954b [33]), in his views, rejects the classical and neo-classical explanation of economic development as a gradual, harmonious process. According to Schumpeter, instead of a gradual and smooth way, development occurs if there is a high degree of risk and uncertainty in an economic environment (Meier and Baldwin, 1957) [34].

Schumpeter explains an 'equilibrium state' in an economic environment with the 'circular flow' principle (Schumpeter, 1954b) [33]. According to 'circular flow', there is a static equilibrium represented by a constantly repeating circular flow of money and goods. The only events in this economic environment are routine changes to which producers and consumers can easily adapt themselves (Dixon, 2000) [39]. Schumpeter’s dynamic theory exposes a disturbance of equilibrium of 'the circular flow' in a constantly growing, static economy by 'cluster of innovations.' Schumpeter believes that, there is no possibility of profiting in the equilibrium state and innovations are essential to make profit. According to Schumpeter, innovations increase the economic activity by activating other innovators-by Schumpeter’s definition, ‘entrepreneur’. This economic activity reaches to a mature state and alleviates itself and economy returns to the state of equilibrium. Thus, Schumpeter believes that innovations lead to the development and growth of the economy, and eventually to prosperity and wealth (Schumpeter, 1939)[11].
According Schumpeter (1942)[32], innovations are the driving forces leading a capitalist economy run. He poses "the fundamental impulse that sets and keeps the capitalist engine in motion comes from new consumer goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates" (Schumpeter, 1942)[32].

In Schumpeter’s Theory of Economic Development, innovation stimulate new innovations, constituting ‘cluster of innovations,’ open new profitable opportunities, obtain profit and growth in the economy, and finally result with an enhancement in the standard of life of the public. Schumpeter suggests that each cluster of innovation-innovations subsequently appearing-is ‘... an avalanche of consumers’ goods that permanently deepen and widen the stream of real income’ (Schumpeter, 1942)[32]. If we look at those avalanches of consumers’ goods, we again find that each of them consists of articles of mass consumption and increases the purchasing power of the wage dollar more than that of any other dollar—in other words, the capitalist process, not by coincidence but by virtue of its mechanism, progressively raises the standard of life of the masses (Schumpeter, 1942)[32]. Therefore, Schumpeter’s theory of innovation suggests that innovation, which is the force behind the capitalist economic system, eventually brings about the growth of the economy and the increment in the standard of life.

1.13 The Generations of Innovation

The first generation (1950s – mid-1960s) was characterized by a strong belief in the omnipotence of technology, and consumer booms which resulted in the Technology Push concept; an in-house linear progression model from R&D originating scientific discoveries to the marketplace (Rothwell, 1994)[40].

The second generation (mid-1960s – early 1970s) saw intensified competition and balanced supply and demand which led to the Market Pull approach; an emphasis on marketing with R&D as a reactive role to realize ideas identified on the market.

The third generation (early 1970s – mid-1980s) abandoned static scale economies for a greater focus on cost control/reduction. Contemporary research pointed out the need for a new model; the Coupling Model, which included both the preceding models and added feedback loops.
Ensuing, the fourth generation (early-1980s – early 1990s) now viewed firms' Core Competence (CC) as the main source of competitive advantage and a way to enter new markets (Prahalad & Hamel, 1990). Focus also turned on globalization, strategic alliances, the ability to overcome problems associated with shorter PLCs, parallel development and wide scale integration (Rothwell, 1994). Later research showed that CC often becomes core rigidities or core incompetence if company growth is too centralized around those CC (O'Connor, 2006).

Fifth generation Rothwell (1990) elaborates on the fourth generation and points out the future importance of speedy innovation processes. Time to market is seen as the new CC. Furthermore, the role of IT, lead users, iterative development sequences and the importance to access external know-how is emphasized.

Table 1.3: Generations of Innovation

<table>
<thead>
<tr>
<th>Generation:</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Emerging fifth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main focus:</td>
<td>Technology Push</td>
<td>Market Pull</td>
<td>Coupling Model</td>
<td>Japanese Production</td>
<td>Speed to Market and IT</td>
</tr>
</tbody>
</table>

1.14 Innovation Process Cycle

With the growing popularity of innovation initiatives, ever more companies are launching their own actions. However, many are going forward in a piecemeal fashion, running a brainstorming event here, trying out ideas campaign there and promoting innovation in vague ways in marketing communications. Such an approach works, somewhat, but it is not ideal.

The best approach is to have a comprehensive innovation process management (IPM) structure that treats innovation as a series of cycles that run within a grand, enterprise innovation process cycle. Fig 1.1 below demonstrates the innovation process management.
1.14.1 Step 1: Formulating innovation challenge

The cycle starts with a problem or goal which needs to be formulated into an innovation challenge. Once this is done, the challenge is presented to the problem solving group. This may be done in the form of a brainstorming event, ideas campaign or other activity. The group problem solving group may be a team, all employees in the firm, the public or any other group of people.

1.14.2 Step 2: Collaborating idea generation

In order to maximise the creative potential of the problem solving group, the idea generation activity should be collaborative in nature. This can be accomplished in many ways. Idea management and innovation process management software often provides on-line collaboration tools, while facilitators of brainstorming and other ideation events should promote collaborative idea development.

1.14.3 Step 3: Combining the ideas

Because an innovation process cycle starts with a challenge, ideas tend to be interrelated and many are complementary. Hence, before going further, it is best to
combine such complementary ideas into larger, more sophisticated ideas so that they can be handled as a single package. This makes the next steps in the cycle more efficient.

1.14.4 Step 4: Scientific Peer Review Evaluation

Here is where a lot of innovation initiatives break down: choosing the best ideas. Many poorly thought out approaches use voting, which is a good way to identify the most popular idea, but an appallingly ineffective method for identifying the most potentially innovative idea. The scientific approach of peer review by expert, on the other hand, is ideally suited for identifying the most promising ideas in a cycle. Instead of basing selection on popularity or the whim of a manager, apply a set of business criteria to the idea and rank how well the idea meets each criterion. If an idea achieves a sufficiently high ranking, either as is or through additional modification, it should be developed further.

1.14.5 Step 5: Testing and Development of ideas

Ideas identified as being potential innovations are now ready to be tested and developed. Here is where typical business tools come in useful. A business case is a useful means of hypothetically implementing an innovative idea and projecting the potential results. Of course it is not perfect, but it indicates possible issues in the implementation of the idea, as well as benefits that may not have been obvious to the original idea developers.

1.14.6 Step 6: Implementation of ideas

Implementation of idea is very important step in innovation process management. Ideas that made through testing and development and which are suited regarding the nature of the business are ready to be implemented in the organization.

1.14.7 Step 7: Review

Once ideas have been implemented, they need to be reviewed, probably against an on going series of milestones. If an implementation does not achieve a milestone, it needs to be modified or killed. Moreover, even the most spectacularly effective and profitable breakthrough innovations need to be improved on a regular basis.
1.14.7 Step 8: New Needs and Inspiration

Reviewing the implementation of new ideas should indicate new needs which can be transformed into challenges which, in turn, start a new innovation process cycle. Likewise, implementations can inspire new corporate goals. Again, these can be turned into new challenges and new cycles.

1.15 Types of Innovations

1.15.1 Radical and Incremental Innovations

It has long been noted that one can differentiate innovations in terms of the degree of novelty associated with them. Some innovations employ a high degree of novelty, while others involve little more than 'cosmetic' changes to an existing design. This distinction between big change and small change innovations has led to group innovations as either radical or incremental (Freeman, 1982) \(^{14}\). However differentiating innovations using just two classes in this way is rather limited and does not bring out the subtle but important differences between innovations. In particular it fails to show where the novelty often lies. To cater for this Henderson and Clark (1990) \(^{44}\) use a more sophisticated analysis. There analysis incorporates both radical and incremental innovation but within a more wide-ranging analysis that is both robust and meaningful. Henderson and Clark’s (1990) \(^{44}\) analytical framework provides a typology that allows us to analyse more modest innovations and at the same time predict their impact in terms of both competition and the marketplace. Although this typology focuses primarily on product innovations that can equally be applied to service and process innovations.

At the heart of Henderson and Clark’s analytical framework is the recognition that products are actually systems. As systems they are made up of components that fit together in a particular way in order to carry out a given function.

Example

\[
\text{Pen} = \text{nib} + \text{ink storage} + \text{stem} + \text{cover} + \text{ink}
\]

\[
\text{System} = \text{interaction of components}
\]

Henderson and Clark (1990) \(^{44}\) point out that to make a product normally requires two distinct types of knowledge:
Component knowledge: knowledge of each of the components that performs a well defined function within a broader system that makes up the product is termed as component knowledge. This knowledge forms part of the ‘core design concepts’ (Henderson and Clark, 1990) embedded in the components.

System knowledge: knowledge about the way the components are integrated and linked together is called as system knowledge. This knowledge about how the system works and how the various components are configured and work together. Henderson and Clark (1990) refer to this as architectural knowledge.

1.15.1.1 Incremental Innovation

Incremental innovation refines and improves an existing design, through improvements in the components. However it is important to stress these are improvements not changes, the components are not radically altered. Christensen (1997) defines incremental innovation in terms of:

“A change that builds on a firm’s expertise in component technology within an established architecture.”

1.15.1.2 Radical Innovation

Radical innovation is about much more than improvements to existing designs. A radical innovation calls for a whole new design, ideally using new components configured (i.e. integrated into the design) in a new way. In Henderson and Clark’s (1990) terms, “Radical innovation establishes a new dominant design, and hence a new set of core design concepts embodied in components that are linked together in a new architecture.” The difference between incremental innovation and radical innovation is given in table 1.4
Table 1.4: Difference between radical and incremental innovation

<table>
<thead>
<tr>
<th>Feature</th>
<th>Radical Innovation</th>
<th>Incremental Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance</td>
<td>• High degree of novelty in product and process innovation.</td>
<td>• Cosmetic changes to an existing product and process innovation.</td>
</tr>
<tr>
<td>Approach</td>
<td>• A fresh look on old problems</td>
<td>• Determination in solving problems within a given framework</td>
</tr>
<tr>
<td>Knowledge base</td>
<td>• Require completely new knowledge to produce new products and process.</td>
<td>• Require advance technology to produce existing products or process.</td>
</tr>
<tr>
<td>Where the innovation takes place</td>
<td>• Radical innovation takes place outside the organisation.</td>
<td>• Incremental innovation takes place within the organisation.</td>
</tr>
<tr>
<td>Outcome factors</td>
<td>• New knowledge and/or technology, gain of long-term competitive advantage, fulfilment of law requirements, availing of tax benefits and other incentives.</td>
<td>• New applications, adoption to immediate competition, utilization of research advances within a firm, adoption to business cycle fluctuations, adoption to consumer interests.</td>
</tr>
<tr>
<td>Determinants</td>
<td>• Needed huge and long-term investments in R&amp;D.</td>
<td>• Needed short-term investment in R&amp;D.</td>
</tr>
</tbody>
</table>

1.15.2 Product and Process Innovation

Innovation is regarded as a crucial factor for the survival and the competitive strength of any industrial firm. Industrial firms have to adapt to increasing global competition and dynamics. Innovation is not solely restricted to products, but rather encompasses business processes as well. Product innovation includes improvements in existing products or creating entirely new products. Process innovation means changes in existing process or adopting entirely new process. The part of new products in the companies' product portfolio increased in the last years. For industrial firms the development of new products and services is the engine of growth. The firm's competitive position is determined by the ability to innovate it's product portfolio and the time required to bring new products to the market. Firms have to launch new sophisticated products in increasingly fast cycles and their ability to ramp up to full scale production volume rapidly is crucial for success (Pisano 1997). With product life cycles getting shorter it becomes even more essential to expand commercial production process capacity rapidly to generate sales revenues and development investments.
Innovation is the focal point in the business strategy of any industrial firm. Industrial Companies are complex and dynamic systems showing numerous interactions with their environment. The management of successful adoption of innovations in these companies is a complex and difficult venture which has to take into account a large number of internal and external factors. Purpose of this paper is the investigation of the mutual interactions and consequences of product and process innovations in manufacturing companies.

For SMEs innovations of the productive system and particularly innovations of the related processes are essential. Due to technological facts there is a tight relationship between technical products and the processes implemented to generate these products. Developing innovation strategies management has to take into account the underlying product-process interactions. Changes in the product system have significant consequences for the firm's manufacturing system and for technical and administrative processes (Utterback, Abernathy 1975\textsuperscript{11}; Hayes, Wheelwright 1979 a \cite{147}, 1979 b \cite{148}; Kim et al. 1992\cite{149}). Before introducing new products changes in process requirements have to be considered.

The tightness of the relationship between product and process features varies with the industrial sector. In the process industries like chemicals, pharmaceuticals, and biotechnology ("Process Driven", "Process Enabling", Pisano 1997\cite{150}) an extraordinary close relationship between products and production process can be noticed. The investigation in this paper focuses on the innovation process in manufacturing industries. Innovation management in manufacturing companies is asked to create integrated innovation and manufacturing strategies. An improved performance of manufacturing companies can be expected from tighter linkages between product and process innovation (Kim et al. 1992\cite{151}). "Managing this product-process connection is one of the top challenges of the era" (Ettlie 1995, p.1224\cite{152}).

For a development of integrated innovation and manufacturing strategies considering the tight product-process interaction an investigation of the interdependencies of product features and the related production processes seems to be useful.
1.15.2.1 Linking Product and Process Innovation

For industrial companies innovations of the product portfolio as well as innovations of the processes generating these products are essential. In many cases the scientific literature focuses either on product innovation or on process innovation without explicitly taking into consideration the interaction between product and process innovation.

The product-process life cycle theory of Utterback and Abernathy (Utterback, Abernathy 1975)[13] provides a useful model helping to understand the pattern of many industrial innovation processes. This model succeeds in encompassing the mutual relationships between the stages of a product's life cycle, the related production process' stages of development and competitive strategy.

By identifying, and then separating, process and product innovations the industrial innovation pattern could be related to three different stages of the innovation process: the uncoordinated, the segmental and the systematic. Utterback and Abernathy noticed that the rate of product or process innovation depends on the present stage of the product's life cycle. It has to be mentioned that this concept can refer to the life cycle of a single product line and its manufacturing process as well as to a specific product generation and the growth of a whole industrial branch related to this generation of products. The process of substitution by a completely different, sophisticated kind of products is not in the focus of investigation. The typical pattern of product and process innovation, including the three different stages.

Stage 1: The first stage of the innovation process—the uncoordinated stage—is characterized by frequent changes in product design and low productivity of the related process. In this stage competition is merely based on product performance, a dominant product design has not evolved yet. Due to the uncoordinated and low integrated production process (technological and organizational) there are low constraints for product improvements. These frequent changes of product features inhibit process standardization efforts, which results in higher production costs.

Stage 2: After the emergence of a dominant product design, the firm—or the industrial branch—gradually enters the segmental stage. Specialized production equipment is introduced, the rate of innovation related to the production process increases, and the
process becomes more coordinated. In this stage product innovations requiring radical changes in the production process are voided, the rising of the product innovation rate diminishes. Production costs decrease which leads to increasing sales and higher production volume.

Stage 3: In the systemic stage complex, highly integrated technological solutions are implemented in the firm; the production system is further standardized while cost minimization becomes an important goal. Tighter linkages between product and process features occur. Product and process changes are highly interdependent which must be taken into consideration by management. The process of standardization reduces the probability of further fundamental innovations in both the product and the process system. Due to these constraints both the product and the process innovation rate decrease.

As Utterback and Abernathy relate the three identified stages to the competitive strategies such as performance maximization, sales maximization, and cost minimization their approach is well descriptive as normative attributes. The model provides explanations about systematic variations in the innovation process of industrial companies-fundamental ideas of possible and plausible cause and effect relationships-suitable for the generation of a system dynamics model.

Implementing the fundamental ideas of the Utterback and Abernathy approach into system dynamics model specific adaptations are to be considered like the recent advances in sophisticated flexible production systems and computer aided manufacturing. These technological innovations in the recent years permit a higher degree of product variation at later stages. Nevertheless the fundamental ideas of this concept can be found in current literature (e.g. Ettlie 1995[50], Damanpour, Gopalakrishnan 1999[151]) and the concept still appears to be valid for many industrial settings (Butler 1988)[52].

Following the concept of Utterback and Abernathy, Hayes and Wheelwright suggest a two dimensional product-process matrix linking product life cycle stage and process life cycle stage and reflecting a company’s position in the interrelated product-process system (Hayes, Wheelwright 1979a[47], 1979b[48]). The matrix represents the interaction of both the product and the process life cycle. The process
life cycle-rows of the matrix represent the process structure with increasing standardization towards the systematic form. The product life cycle columns represent the product structure going from great variety to highly standardized products. This matrix is helpful in describing industrial companies’ strategic options particularly with regard to the manufacturing function. The Hayes and Wheelwright matrix concept provides substantial support in determining the direction and timing of innovation decisions in the light of a company’s manufacturing capabilities.

Building on the ideas of Hayes and Wheelwright and the generic strategy typology proposed by Porter an ongoing conceptual framework is provided by Kotha/Orne. Using the dimensions “product line complexity” and “process structure complexity” this framework suggests a link between several critical elements in manufacturing competitiveness (Kotha, Orne 1989). It considers both the content and the process fit between structure, strategy, technology and performance. It recognizes that the execution of the more generic business unit strategy inherently involves manufacturing and postulates link between business-level strategy and manufacturing structure.

Kotha and Orne relate high process structure complexity in manufacturing and lower product line complexity to the strategy of cost leadership while the strategy of differentiation is related to higher product line complexity and lower process structure complexity. The company’s “process structure complexity” is characterized by the level of mechanization, systemization and interconnection of the production process while “product line complexity” is mainly characterized by the end product’s complexity and variety and it’s maturity in the product life cycle.

The frameworks of Utterback and Abernathy, Hayes and Wheelwright and Kotha and Orne represent integrative approaches all succeeding in illustrating the tight interconnections between product, process and strategy in manufacturing companies. Applied to industrial innovation management these synthesized frameworks give valuable hints for the development and implementation of specific types of innovation. They provide support for decision-making concerning the specific type, the timing and the extent of innovation in relation to maturity in product life cycle, manufacturing structure as well as in relation to manufacturing strategy and competitive strategy.
1.15.3 Open and Closed Innovation

Traditionally, large firms relied on internal R&D to create new products. In many industries, large internal R&D labs were a strategic asset and represent a considerable barrier to entry for potential entrants. As a result, large firms with extended R&D capabilities and complementary assets could outperform smaller rivals (Teece, 1986)\(^5^4\). This process in which large firms discover, develop and commercialize technologies internally has been labelled as 'closed innovation' (Chesbrough, 2003)\(^5^5\). For a long time, closed innovation has been a very successful way used by companies to sustain a competitive advantage in their different businesses.

However, the innovation landscape has changed considerably: good ideas are widely distributed with no firm having a monopoly, venture capital is abundant nowadays and the acceleration of the product life cycle has turned intellectual property (IP) into an increasingly perishable asset. As a result, a growing number of large Multi National Enterprises (MNEs) have been moving from an internally focused innovation process to one that is more ‘open’. In this new era of 'open innovation', firms use both internal and external pathways to exploit technologies and, concurrently, they scout different external sources of technology that can accelerate their innovation process (Chesbrough, 2003)\(^5^5\).

Many companies fail to fully capitalize on internal R&D (Chesbrough, 2003a)\(^5^6\). The ruling logic of generating and marketing ideas has changed; upstarts have exerted great competition on leading enterprises and conduct very little or no basic research, and market ideas in a whole new fashion. Harnessing external ideas whilst leveraging in-house R&D outside the firm’s current operations is the essence of open innovation (OI) (Chesbrough, 2003b)\(^5^7\). The closed innovation (CI) linear model required total control for successful innovation; from idea generation to marketing (Rothwell, 1994\(^4^0\); Chesbrough, 2003b \(^5^7\)). Industry practice was to invest profits from internal R&D breakthroughs into new R&D projects (Chesbrough, 2003a)\(^5^6\). The implications for R&D managers are obvious; internal R&D success needed the best researchers; intellectual property (IP) management is essential and with a strong pursuit for defensive IP comes a natural aversion for outside sources of knowledge.
Chesbrough (2003b) put together a list of contrasting principles between closed innovation (CI) and open innovation (OI). The difference between closed and open innovations is presented in the table 1.5.

Table 1.5: Difference between closed innovation and open innovation

<table>
<thead>
<tr>
<th>Field of Expertise</th>
<th>Closed Innovation Principles</th>
<th>Open Innovation Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functions of the own R&amp;D</td>
<td>Firms need internal R&amp;D to discover, develop newness.</td>
<td>Firms use external R&amp;D to develop newness.</td>
</tr>
<tr>
<td>Attitude Regarding Research</td>
<td>Research projects necessarily originate from in-house conceptualization.</td>
<td>Research projects do not necessarily originate from in-house, can originate from customers, other companies etc.</td>
</tr>
<tr>
<td>Market Ambition</td>
<td>Gives first priority to commercializing an innovation.</td>
<td>Building a better business model than getting to market first.</td>
</tr>
<tr>
<td>Sources for Ideas</td>
<td>Firms that can generate and develop ideas in-side the organisations.</td>
<td>Firms make use of internal and external ideas to advance their business.</td>
</tr>
<tr>
<td>Intellectual Property</td>
<td>Firms should get profits by use of their own IP in closed innovation.</td>
<td>Firms should get profits by use of others IP.</td>
</tr>
</tbody>
</table>

1.15.3.1 Innovation continuum

Whilst no company is on either end of the scale since it is more of a continuum than a dichotomy it is still interesting to illustrate the differences between open innovation (OI) and closed innovation (CI) in its extremes. Closed innovation (CI) companies will manage their radical innovations (RI) processes way differently than open innovation (OI) companies. Since radical innovation (RI) inherently demands new market and technical knowledge, open innovation (OI) companies will have the upper hand in a number of areas, e.g. closed innovation (CI) companies who focus on in-house development often reinvent the wheel and overlook already functional solutions. Fig. 1.2 below demonstrates closed innovation (CI) and fig. 1.3 open innovation (OI) at their extremes, in reality no company is closed innovation (CI) or open innovation (OI) on all accounts and exist more on a continuum between open innovation (OI) and closed innovation (CI) in several aspects. In the closed innovation (CI) method (shown below in Fig.1.2) companies focus on research projects that originate from within the company boundaries, research these and only continue to develop those that are supported by the current business model. The
project is then taken through in-house development where the concept is that it was selected during the research phase and is developed into a complete market ready product/service which then is marketed to become an innovation.

Figure 1.2: An illustration of the Closed Innovation Model as depicted in Chesbrough, 2003b

With open innovation (OI) the process (shown below in Fig.1.3) of radical innovation (RI) is somewhat different. Always research projects do not necessarily originate from in-house conceptualization. Project can here originate from customers and other companies. These projects are then developed into market ready concepts, but with a difference: those that are not supported by the current business model and can have the option of exploitation through spin-offs, joint ventures and licensing. Thus open innovation process evolved.
As aforementioned, the closed innovation (CI) process is nearing its end. Chesbrough (2003a, 2003b, 2003c, 2006) has given following reasons that are solving closed innovation process to its end. Those are:

- Increased mobility of competent technical and managerial personnel across firms
- Raising quality and relevance of university research
- The explosion of college graduates and increasing quality and quantity of human capital
- Growing quality and quantity of international research
- Emergence of venture capital and private equity

Venture capital and corporate incubators support nascent companies' ability to threaten existing establishments (Gassmann, 2006). Prototyping is also cheaper, opening up the possibility for customers to try out new concepts at reduced costs (Kobe, 2006). This combined shifts the locus of innovation to startups, universities, research consortia and other outside organizations (Chesbrough, 2003b). Finally, shorter PLCs and the need for faster time to markets pushes R&D managers to eschew a closed innovation approach (Allio, 2005; Enkel, Gassmann, & Chesbrough, 2009).
Managers can exploit open innovation (OI) in three main areas: funding, generating and commercializing. Since most companies lack clearly formulated radical innovation (RI) project budgets, R&D managers need to connect radical innovation (RI) project proposals with appropriate funding channels provided by the firm (Chesbrough, 2003b)[57].

Generation of innovation can be explorative or exploitative in nature. Regardless of type managers need to support the use of external knowledge sources. Commercialization can be done either through a focus on profitably market ideas through in-depth customer knowledge, or building a portfolio of the best ideas regardless of source. Both these methods come with a different set of challenges and managerial implications.

The appropriateness of open innovation (OI) depends on the industry context. Enkel et al. (2009)[63] points out; the open innovation (OI) paradigm, pertaining aspects and strategic implications are not suitable for industry that are not; global, technology intensive, operate where different schools of science meet, in need of new business models and knowledge leveraging. In general one could say that firms that can harness outside ideas to advance their own business while leveraging their internal ideas outside their current operations will likely thrive in this new era of open innovation. (Chesbrough, 2003b)[57]. Eric von Hippel claims that open innovation (OI) can prove to be beneficial across all industry sectors (Wilson, 2009)[64], and research has shown an open innovation (OI) adoption throughout all industry sectors, whilst perceived benefits are somewhat different open innovation (OI) still seems to permeate industry strategies regardless of field, technology level or size (Chesbrough & Crowther, 2006)[65]. Open innovation (OI) manifests itself in one of three key processes:

- The Inside-out
- The Outside-in, and
- The Coupled process

The Inside-out process advocates profiting from bringing ideas to market, selling IP, and multiplying technology by transferring ideas to the outside environment. First time to market is the key focus and is, if need be, achieved by shifting the locus of
exploitation outside the company's boundaries. Companies should not restrict itself to the market it serves directly but should expand using licensing, joint ventures, spin-offs etc. These different streams of income create more overall revenue from innovations (Enkel, Gassmann, & Chesbrough, 2009).

The Outside-in process is all about the integration of suppliers, customers and external knowledge sourcing that enriches the company's own knowledge base. Managers must realize that the locus of innovation and knowledge are not necessarily the same. Importance of innovation networks, new means of customer integration (e.g. crowd sourcing), mass customization, customer community integration and the use of innovation intermediaries such as innocentive and nine sigma, are all part of the Outside-in process (Enkel, Gassmann, & Chesbrough, 2009).

The two former processes were coupled with mainly complementary partners through alliances with co-creation. Co-operations and joint ventures during which both an inside-out (to market ideas) and an outside-in (to gain external knowledge) process is crucial for success (Enkel, Gassmann, & Chesbrough, 2009).

1.16 Sources of Innovation

Peter Drucker (1998) identified seven sources of innovation: (i) unexpected occurrences, (ii) incongruities of various kinds, (iii) process needs, (iv) changes in an industry or market, (v) demographic changes, (vi) changes in perceptions, and (vii) new knowledge. (These seven sources overlap, and the potential for innovation may lie in more than one area at a time.) He explained that purposeful, systematic innovation begins with the analysis of the sources of new opportunities. However, he emphasized that in seeking opportunities, innovative organizations need to look for simple, focused solutions to real problems. That takes diligence, persistence, ingenuity, and knowledge.

1.16.1 Unexpected Occurrence: consider, first, the easiest and simplest source of innovation opportunity: the unexpected. In the early 1930s, IBM developed the first modern accounting machine, which was designed for banks. But banks in 1933 did not buy new equipment. What saved the company — according to a story that Thomas Watson, Sr., the company's founder and long-term CEO, often told — was its
exploitation of an unexpected success: the New York Public Library wanted to buy a
machine. Unlike the banks, libraries in those early new deal days had money, and
Watson sold more than a hundred of his otherwise unsalable machines to the libraries.

Fifteen years later, when everyone believed that computers were designed for
advanced scientific work, business unexpectedly showed an interest in a machine that
could do payroll. Univac, which had the most advanced machine, spurned business
applications. But IBM immediately realized it faced a possible unexpected success,
redesigned what was basically Univac’s machine for such mundane applications as
payroll, and within five years became the leader in the computer industry, a position it
has maintained even to this day.

The unexpected failure may be an equally important innovation-opportunity
source. Everyone knows about the Ford Edsel as the biggest new-car failure in
automotive history. Very few people know, however, that the Edsel’s failure was
the foundation for much of the company’s later success. Ford planned the Edsel, the
most carefully designed car to that point in American automotive history, to give the
company a full product line with which to compete with General Motors. When it
bombed, despite all the planning, market research, and design that had gone into it,
Ford realized that something was happening in the automobile market that ran counter
to the basic assumptions on which General Motors (GM) and everyone else had been
designing and marketing cars. No longer was the market segmenting primarily by
income groups; the new principle of segmentation was by lifestyles. Ford’s response
was the Mustang – a car that gave the company a distinct personality and re-
established it as an industry leader.

Thus unexpected successes and failures are productive sources of innovation
opportunities because most businesses dismiss them, disregard them, and even resent
them. The German Scientist who around 1905 synthesized novocaine, the first non-
addictive narcotic, had intended it to be used in major surgical procedures like
amputation. Surgeons, however, preferred total anaesthesia for such procedures; they
still do. Instead, novocaine found a ready appeal among dentists. Its inventor spent the
remaining years of his life travelling from dental school to school making speeches
that forbade dentists from “misusing” his noble invention in applications for which he
had not intended it.
This is a caricature, to be sure, but it illustrates the attitude of managers often take unexpectedly; "It should not have happened." Corporate reporting systems further ingrain this reaction, for they draw attention away from unanticipated possibilities. The typical monthly or quarterly report has on its first page a list of problems—that is, the areas where results fall short of expectations. Such information is needed, of course; it helps prevent deterioration of performance.

But it also suppresses the recognition of new opportunities. The first acknowledgement of a possible opportunity usually applies to an area in which a company does better than budgeted. Thus genuinely entrepreneurial businesses have two “first pages”—a problem page and an opportunity page—and managers spend equal time on both.

1.16.2 Incongruities: Alcon Laboratories was one of the success stories of the 1960 because Bill Conner, the company’s cofounder, exploited an incongruity in medical technology. The cataract operation is the world’s third or fourth most common surgical procedure. During the last 300 years, doctors systematized it to the point that the only “old-fashioned” step left was the cutting of a ligament. Eye surgeons had learned to cut the ligament with complete success, but it is a different procedure from the rest of the operations, and so incompatible with it, that they often dreaded it. It was incongruous. Doctors had known for 50 years about an enzyme that could dissolve the ligament without cutting. Alcon added a preservative to this enzyme that gave it a few months’ shelf life. Eye surgeons immediately accepted the new compound, and Alcon found itself with a worldwide monopoly. Fifteen years later, Nestle bought the company for a fancy price. Such an incongruity within the logic or rhythm of a process is only one possibility out of which innovation opportunities may arise. Another source is congruity between economic realities. For instance, whenever an industry has a steadily growing market but falling profit margins—as, say, in the steel industries of developed countries between 1950 and 1970—an incongruity exists. The innovative response: minimills.

An incongruity between expectations and results can also open up possibilities for innovation. For 50 years after the turn of the century, shipbuilders and shipping companies worked hard both to make ships faster and to lower their fuel consumption.
Even so, the more successful they were in boosting speed and trimming fuel needs, the worse the economics of ocean freighter was dying, if not already dead.

All that was wrong, however, was an incongruity between the industry’s assumptions and its realities. The real cost did not come from doing work (that is, being at sea) but from not doing work (that is, sitting idle in port). Once managers understood where costs truly lay, the innovations were obvious: the roll-on and roll-off ship and the container ship. These solutions, which involved old technology, simply applied to the ocean freighter what railroads and truckers had been using for 30 years. A shift in viewpoint, not in technology, totally changed the economics of ocean shipping and turned it into one of the major growth industries of the last 20 to 30 years.

1.16.3 Process Needs: Anyone who has ever driven in Japan knows that the country has no modern highway system. Its roads still follow the paths laid down for – or by-oxcarts in the tenth century. What makes the system work for automobiles and trucks is an adaptation of the reflector used on American highways since the early 1930s. This reflector lets each car see which other cars are approaching from any one of a half-dozen directions. This minor invention, which enables traffic to move smoothly and with a minimum of accidents, exploited a process needs.

The media had their origin in two innovations developed around 1890 in response to a process need. One was Ottmar Mergenthaler’s Linotype, which made it possible to produce a newspaper quickly and in large volume. The other was a social innovation, modern advertising, invented by the first true newspaper publishers, Adolph Ochs of the New York Times, Joseph Pulitzer of the New York world, and William Randolph Hearst. Advertising made it possible for them to distribute news practically free of charge, with the profit coming from marketing.

1.16.4 Industry and Market Change: Managers may believe that industry structures are ordained by the Good Lore, but these structures can-and often do-change overnight. Such change creates tremendous opportunity for innovation.

One of American business’s great success stories in recent decades is the brokerage firm of Donaldson, Lufkin & Jenrette, recently acquired by the Equitable
Life Assurance Society. DL&J was founded in 1960 by three young men, all graduates of the Harvard Business School, who realized that the structure of the financial industry was changing as institutional investors became dominant. These young men had practically no capital and no connections. Still, within a few years, their firm had become a leader in the move to negotiated commissions and one of Wall Streets stellar performers. It was the first to be incorporated and go public.

In a similar fashion, changes in industry structure have created massive innovation opportunities for American health-care providers. During the last 10 to 15 years independent surgical and psychiatric clinics emergency centres and HMOs have opened throughout the country. Comparable opportunities in telecommunications followed industry upheavels—both in equipment (with the emergence of such companies as Rolm in the manufacturing of private branch exchanges) and in transmission (with the emergence of MCI and Sprint in long-distance service).

When an industry grows quickly the critical figures seems to be in the neighbourhood of 40% growth in ten years or less—its structure changes. Established companies, concentrating on defending what they already have, tend not to counterattack when a newcomer challenges them. In-deed, when market or industry structures change, traditional industry leaders again and again neglect the fastest growing market segments. New opportunities rarely fit the way the industry has always approached the market, defined it, or organized to serve it. Innovators therefore have a good chance of being left alone for a long time.

1.16.5 Demographic Changes: Of the outside sources of innovation opportunity, demographics are the most reliable. Demographic events have known lead times, for instance, every person who will be in the American Labour force by the year 2000 shall have already born. Yet policy makers often neglect demographics, those who watch them and exploit them can reap great rewards.

The Japanese are ahead in robotics because they paid attention to demographics. Everyone in the developed countries around 1970s or so knew that there was both a baby bust and an education explosion going on; half or more of the young people were staying in school beyond high school. Consequently, the number of people available for traditional blue-collar work in manufacturing was bound to
decrease and become inadequate by 1990. Everyone knew this, but only the Japanese acted on it, and they now have a ten-year leader in robotics.

Much the same is true of Club Mediterranee's success in the travel and resort business. By 1970, thoughtful observers could have seen the emergence of large number of affluent and educated young adults in Europe and the United States. Not comfortable with the kind of vacations their working-class parents had enjoyed — the summer weeks at Brighton or Atlantic City — these young people were ideal customers for a new and exotic version of the "hangout" of their teen years.

Managers have known for a long time that demographics matter, but they have always believed that population statistics change slowly. In this century, however, they don't. Indeed, the innovation opportunities made possible by changes in the numbers of people—and in their age distribution, education, occupations, and geographic location—are among the most rewarding and least risky of entrepreneurial pursuits.

1.16.6 Changes in Perception: "The glass is half-full" and "The glass is half-empty" are descriptions of the same phenomenon but have vastly different meanings. Changing a manager's perception of a glass from half-full to half-empty opens up big innovation opportunities.

All factual evidence indicates, for instance, that in the last 20 years, Americans' health has improved with unprecedented speed—whether measured by mortality rates for the newborn, survival rates for the very old, the incidence of cancers (other than lung cancer), cancer cure rates, or other factors. Even so, a collective hypochondrium grips the nation. Never before has there been so much concern with or fear about health. Suddenly, every thing seems to cause cancer or degenerative heart disease or premature loss of memory. The glass is clearly half-empty.

Rather than rejoicing in great improvements in health, Americans seem to be emphasizing how far away they still are from immortality. This view of things has created many opportunities for innovations: markets for new health-care magazines, for all kinds of health foods, and for exercise classes and jogging equipment. The
fastest growing new U.S. business in 1983 was a company that makes indoor exercise equipment.

A change in perception does not alter facts. It changes their meaning, through-and very quickly. It looks less than two years for the computer to change from being perceived as a threat, and as something only big businesses would use, to something one buys for doing income tax. Economics do not necessarily dictate such a change; in fact, they may be irrelevant. What determines whether people see a glass as half-full or half-empty is mood rather than fact, and a change in mood often defies quantification. But it is not exotic. It is concrete. And it can be exploited for innovation opportunity.

1.16.7 New Knowledge: Among history making innovations, those based on new knowledge—whether scientific, technical, or social—rank high. They are the superstars of entrepreneurship; they get the publicity and the money. They are what people usually mean when they talk of innovation, although not all innovations based on knowledge are important.

Knowledge-based innovations differ from all others in the time they take, in their casualty rates, and in their predictability, as well as in the challenges they pose to entrepreneurs. Like most superstars, they can be temperamental, capricious, and hard to direct. They have, for instance, the longest lead time of all innovations. There is a protracted span between the emergence of new knowledge and its distillation into usable technology. Then there is another long period before this new technology appears in the market place in products, processes, or services. Overall, the lead time involved is something like 50 years, a figure that has not shortened appreciably throughout history.

To become effective, innovation of this sort usually demands not one kind of knowledge but many. Consider one of the most potent knowledge-based innovations: modern banking. The theory of the entrepreneurial bank—that is, of the purpose-full use of capital to generate economic development—was formulated by the Comte de Saint-Simon during the era of Napoleon. Despite Saint-Simon’s extraordinary prominence, it was until 30 years after his death in 1825 that two of his disciples, the
brothers Jacob and Isaac Pereire, established the first entrepreneurial bank, the Credit Mobilier, and ushered in what now called as finance capitalism.

The Pereires, however, did not know modern commercial banking, which developed at about the same time across the channel in England. The Credit Mobilier failed ignominiously. A few years later, two young men—one an American, J.P. Morgan, and one a German, Georg Siemens—put together the French theory of entrepreneurial banking and the English theory of commercial banking to create the first successful modern banks, J.P. Morgan & Company in New York and the Deutsche Bank in Berlin. Ten years later, a young Japanese, Shibusawa Eiichi, adapted Siemens’s concept to his country and thereby laid the foundation of Japan’s modern economy. This is how knowledge-based innovation always works.

To cite the computer, is another example, required no fewer than six separate strands of knowledge:

- Binary arithmetic;
- Charles Babbage’s conception of a calculating machine, in the first half of the nineteenth century;
- The punch card, invented by Herman Hollerith for the U.S. census of 1890;
- The audion tube, an electronic switch invented in 1906;
- Symbolic logic, which was developed between 1910 and 1913 by Bertrand Russell and Alfred North Whitehead;
- Concepts of programming and feedback that came out of abortive attempts during World War I to develop effective anti-aircraft guns.

Although all the necessary knowledge was available by 1918, the first operational digital computer did not appear until 1946.

Long lead times and the need for convergence among different kinds of knowledge explain the peculiar rhythm of knowledge-based innovation, its attractions, and its dangers. During a long gestation period, there is a lot of talk and little action. Then, when all the elements suddenly converge, there is tremendous excitement and activity and an enormous amount of speculation. Between 1880 and 1890, for example, almost 1000 electric apparatus companies were founded in developed countries. Then, as always, there was a crash and a shakeout. By 1914,
only 24 were still alive. In the early 1920s, 300 to 500 automobile companies existed in the United States; by 1960, only 4 remained.

It may be difficult, but knowledge-based innovation can be managed. Success requires careful analysis of the various kinds of knowledge needed to make an innovation possible.

Both J.P. Morgan and Georg Siemens did this when they established their banking ventures. The Wright brothers did this when they developed the first operational airplane.

Careful analysis of the needs and, above all, the capabilities of the intended user is also essential. It may seem paradoxical, but knowledge-based innovation is more market dependent than any other kind of innovation. De Havilland, a British Company, designed and built the first passenger jet airplane, but it did not analyze what the market needed and therefore did not identify two key factors. One was configuration—that is, the right size with the right payload for the routes on which a jet would give an airline the greatest advantage. The other was equally mundane: how could the airlines finance the purchase of such an expensive plane. Because Havilland failed to do an adequate user analysis, two American companies, Boeing and Douglas, took over the commercial jet-aircraft industry.

1.17 Significance of Innovation in Industries

Over the past few years, innovation in India as a corporate theme has constantly gained importance, becoming a prerequisite for long-term success, or maybe even survival, due to the discontinuous pace of change of the environment due to Globalization and Privatization. Thus, innovation has now reached for some companies as a corporate priority, affecting every single aspect of an organisation. This shows that innovation, although mostly focused in the area of research and development, and marketing, should not be compartmentalised from the rest of the company, but rather integrated at every level, in order to be fully effective and to be in line with corporate strategy and goals.
1.18 Principles and Strategies of Innovation

Professor Peter F. Drucker (1993) lists several principles which should be represented by innovators. He has grouped these principles in “Do’s” and “Don’ts” in the process of innovation.

Do’s

- **Innovation starts with analysis of opportunities:** It starts with the seven opportunities for innovation. They are: unexpected events, disagreements in the process, requirements of the process and unexpected changes in industry or market structure, demographic changes, changes in perception, importance and new knowledge.

- **Innovation is a conceptual and perceptual activity:** The second imperative of the innovation is to go out and see, ask and hear. Successful innovators work analytically on the question what should be innovation be like in order to satisfy an opportunity.

- **Innovation, in order to be successful, should be simple and focused:** If the innovation is not simple, it will not succeed. Everything new gets into trouble: if it is complicated, it cannot be corrected or solved. All successful innovations are surprisingly simple. In fact, the greatest acknowledgement for an innovation is when people say: This is so obvious.

- **Innovation should start as “small”:** Innovation should not be grandiose. It should hold up to something specific, concrete. In the beginning, it requires a little money, some people and a small limited market.

- **A successful innovation aims towards leadership:** If an innovation at the very beginning does not aim towards leadership, it is highly probable that it will not be “innovative” enough.

Don’ts

- **Innovations should not be very “smart”:** innovation should be led by simple people. Everything that is done in a very “smart” way, either for the designing or the completion, is set to failure by high probability.
• Many things should not be done at a time: innovations have a need for concentrated energy and common effort. It also requires that people who effectuate the innovation should have mutual understanding.

• Don’t innovate for the future, but for the present: one innovation can have a long-term impact, but it demands a longer time to reach its maturity. It should be a solution for the problems in the present.

There are many other principles that give life to the process of innovation. They are:

• Innovation starts when people convert problems to ideas: New ideas are born through questions, problems and obstacles. The process of innovation is indebted to the trouble that comes about when we are surrounded by that which is not solved, not smooth and not simple. Therefore, in order for the innovation process to flourish, it needs a climate that encourages inquiry and welcomes problems.

• Innovation needs a system: All organizations have innovation systems. Some are formal, designed by the leadership and some are informal, taking place outside established channels. Informal channels are untidy and inefficient, yet innovation is always associated with them.

• Passion is the fuel and pain is the hidden ingredient: Ideas do not propel themselves; passion makes them go. Passion, in addition to talent and skill, is a valuable company asset. Passion is what transforms other resources into profits, but it never shows up on a balance sheet. Unfortunately, there seems to be some universal law that says when pursuing a passion or following a dream, pain is part of the process. Innovation leaders need to take the pain with the passion and learn to manage both effectively.

• Co-locating drives effective exchange: Co-location refers to physical proximity between people. It is a key for building the trust that is essential to the innovation process. It also increase the possibility for greater exchange of information, cross-fertilization of ideas and stimulation of creative thinking in one another and critique of ideas during their formative stage.

• Differences should be leveraged: The differences that normally divide people – such as language, culture, race, gender and thinking and problem solving styles – can be a boon to innovation. When differences are used constructively and people
move beyond fear, suspension, mistrust and prejudice, differences can be leveraged to enhance and sustain the innovation process.

The 2007 Booz Allen Hamilton report on Global Innovation 1000 companies argues that statistical analysis of a representative sample of global innovation 1000 companies divided them into three distinct categories of innovation strategy: Need Seekers, Market Readers and Technology Drivers.

Need seekers companies focus on being first to bring new products to markets and base their R&D efforts on getting direct, proactive input from customers. They engage actively current and potential customers to shape new products, services and processes.

Market Readers distinguished themselves through their preferences for incremental change and being fast followers into markets. They watch markets carefully and maintain a more cautious approach focusing on creating values through incremental change.

Technology Drivers focus on a technology forward approach to innovation, while remaining less concerned with direct customer input into the process. They follow the direction suggested by their technological capabilities, leveraging their investment in research and technology to drive breakthrough innovation or incremental change.

There were significant performance differences between the three categories: R&D spending was 40% greater in the Need Seekers group. Each group showed a similar mean values for return on assets, but the standard deviation for Technology Drivers was 40% higher, indicating that this group pursues a riskier innovation strategy than the two other categories.

1.19 Innovation Management

Innovation management is the economic implementation and exploitation of new ideas and discoveries, and the implementation of an innovation culture in an organization, to promote and make possible development of new ideas and business
opportunities. Innovation management consists of innovation strategy, culture, idea management and implementation of innovation processes.

1.20 Meaning of Innovation Management

Innovation management is management of the innovation process. This means the analysis, documentation, and control of change within an organisation. Innovation management is typically performed at the management level of an organisation and deals with generalities that affect the entire organisation, rather than specifics, which affect only a small part of the organisation. This direction might take form of changes in corporate policy, lines of business to follow, or employee policy.

1.21 Approaches of organizations to innovate

Large organisations will typically have a dedicated research and development department with formalised procedures. Smaller organisations frequently do not have a designated department; however, due to their flexible nature the entire organisation can be treated as a productive research and development department. The entire organisation implements change and business processes quickly without all of the formal need for procedures required by large organisations. This has the obvious advantage of creating an agile organisation with the ability to deploy of changes rapidly. However, the major disadvantage of an organisation working in this manner is that a commercially high-risk environment is created. For this reason innovation should be carefully managed so as to keep the organisational risk at a minimum.

We want to see the internal quality of companies, to be understood to enhance innovation management in SMEs. Globalization, informational integration, intense competition circumstance are threat for companies, especially in small and medium manufacturing companies which are less competitive compared to bigger companies. If an enterprise wants to survive, it must keep continual innovation. Innovation management is a central issue. Analyzing innovation management depends on two aspects, open innovation practices (technology exploitation and technology exploration) and innovation culture that enterprises will introduce in their statistical framework. If enterprise wants to strengthen its innovation management, it must focus on these aspects. Because in this challenged external environment, the enterprises must create and use the new innovation management ideas to guide the enterprise
management, and find the new ways to achieve innovation. The innovation management idea is the base. The open innovation is the important in innovation management. Only having the technology supporting, the open innovation practices can be implemented. So innovating technology can help enterprise solves the new problems and meet the demands of customers in time. The environment is very important in the process of innovation management, so innovation culture can help an enterprise to establish a good environment. The enterprise culture can make the enterprise keeping longer competition. Innovation culture can inspire employees to learn new things and create new ideas.

1.22 Innovation Management Characteristics

1.22.1 Based on Knowledge

Organizations strive towards structural and process innovations by creation, acquisition and deployment of both tacit and explicit knowledge. Organizational innovation is not a one-time product of knowledge creation and application. Innovations within an organization are not random; they occur in relation to the past and present conditions of the organization. It is a continuous process of utilizing current and future knowledge and formal and non-formal knowledge. These different kinds of knowledge represent different contents of knowledge within an organization, such as ‘know why’, ‘know what’, and ‘know how’. ‘Know why’ is the theoretical understanding, ‘know what’ is the strategic understanding and ‘know how’ is the practical understanding. The systematic Organizational Development interventions help accelerate the application and integration of knowledge, leading to building of competencies and capabilities required for innovation.

1.22.2 Based on Culture

The source of innovation in an organization is the cumulative articulations of individuals and groups. These articulations are triggered by appropriate choice of competitive strategies and channelled by creating an enabling culture and networking of people, information and other resources. Participation in the decision to innovate tends to raise the commitment is associated with more successful innovation.
1.22.3 Based on Need

Necessity is the mother of invention. The urge to innovate is strengthened when the inventor or inventive organization identifies a specific need. The Germans developed rocketry and ballistic missiles to destroy England. America made the atom bomb to crush Japan. The allies developed radar and sonar to protect them. All these inventions turned out to be quite beneficial in peace time. Rocket and missiles opened the way for space exploration and epochal landing of man on the moon. Atomic power is now being used for power generation and other purposes.

1.23 Components of innovation management

There is no simple universal formula for successful innovation: it is nonlinear, works at many levels, and is too complex to be pinned down in that way. It is uniquely human and cannot be done by machines. Nevertheless, innovations are not random: they occur in relation to the past, present, and future conditions of an organization. The characteristics of innovation systems are that they recruit and retain highly skilled and trained personnel, give them access to knowledge, and then encourage and enable them to think and act innovatively. Components of an effective innovation management include

- Clarity in mission statements and goals, which invariably feature a commitment from senior managers to assume responsibility for the risk of failure.
- An organizational culture that values innovation, where there is encouragement for personnel to think differently, take calculated risks, and challenge the status quo. Major forces such as leadership, attitudes to risk, budgeting, audit, performance measurement, recruitment, and open innovation are aligned in support.
- A systems approach to management that understands innovation as one part of a wider context, appreciates interconnections, and can conduct systematic analyses of how a problem interacts with other problems, parts of the organization and projects. Management fosters coordination across these interconnections and stresses integration rather than compartmentalization.
- The adequate resourcing of innovation in line with strategy.
- The placing of responsibility for innovation on all staff.
Understanding that creativity is desirable but insufficient. Innovation ambassadors must still take responsibility for follow-through.

An enriched physical workplace that enhances creativity by providing accessible, casual meeting spots; physical stimuli; space for quiet reflection; a variety of communication tools, e.g., white boards, bulletin boards; contact space for clients, audiences, and partners; and room for individual expression, among others.

Human resource systems that ensure staff have diverse thinking (or learning) styles, giving them a variety of perspectives on single problems.

Team setups that avoid groupthink and balance the beginner’s mind with experience, freedom with discipline, play with professionalism, and improvisation with planning. Teams embody divergent and convergent thinking, diverse thinking styles, and diversity of skills; and handle conflict.

High levels of decentralization and functional differentiation and a range of specialized areas within the organization.

Honed knowledge management systems and processes that constantly bring new ideas, concepts, data, information, and knowledge into the organization.

Numerous and empowered members of relevant communities and networks of practice.

Processes and methodologies that identify and share good practice.

A performance measurement system that measures the innovative pulse of the organization; ensures monitoring and evaluation of inputs, activities, outputs, outcomes, and impacts; and feeds lessons back to the system.

The instigation of incentives and rewards for innovative individuals and teams.

Plentiful space for creative thinking and reflective practice, e.g., away-days, brainstorming sessions, peer assists, after-action reviews and retrospects, problem-solving groups, discussion groups and forums.

Linkages with the marketing function, in ways that involve stakeholders and seek regular feedback.

Effective dissemination systems.

Dedication information systems that ensure positive coverage and publicize success.

Structured intellectual property management systems that identify, protect, value, manage, and audit the organization’s intellectual property.
1.24 Barriers to innovation among Indian SMEs

Barriers to innovation can be broadly classified as:

1.24.1 Managerial barriers

1.24.2 Financial barriers

1.24.3 Technological barriers

1.24.1 Managerial Barriers

India has a protected market economy before liberalization. The Indian industrial environment was traditionally identified by its regulative and protective characteristics. Till 1990, the Indian economy was inward looking and protected from internal and external competition. In the absence of competition, firms did not develop the technological capability needed for penetrating the global market. This decade’s long protective environment also reduced the risk taking capacity of the SMEs manager and made him/her complacent and averse to risk.

Earlier, Indian firms had quite often followed an opportunistic approach to growth, as opposed to capability driven approach that seeks to strengthen key aspects of manufacturing. Consequently, firms have paid very little strategic attention to their shop floors in the last few decades. Today Indian industry is facing tough competition from imports in the domestic markets also. This competition is in terms of new designs, new usages, reduced cost, improved quality, products with higher performance and variety, better services, all delivered simultaneously to enhance values to the customers.

Adopting an innovation is risky by definition. It is possible for most SMEs to deal with perceived risk, if they have enough time and resources. They need time to think and reflect on the benefits versus the level of risk involved. They also need resources to investigate the pros and cons of a proposed innovation, e.g. customer reactions, financing, and production capacity. Unfortunately, today both time and resources are in short supply.

1.24.1.1 Some of the measures mentioned below will enhance the capacity of the Indian SMEs:

The Government of India has established a net work of entrepreneurship development institutes including 3 national level institutes, for imparting...
entrepreneurial education and training. These Institutes are responsible for development of training modules and undertaking of research and training for meeting the needs of the SME manager. They work in close coordination with the local industrial associations.

Most of the SMEs do not have access to well researched database whether it pertains to market intelligence or technology. This information needs to be provided to them proactively on a regular basis. Government of India SIDO website www.smallindustryindia.com and www.laghu-udyog.com are dynamic portals, while NSIC also runs its own info-dairy services on its website: www.nsicindia.com and www.techshowindia.com.

Besides, Government of India also provides financial assistance for surveys, studies, participation in foreign exhibitions, business meets, marketing assistance, vender development program, subcontracting, Prime Minister’s employment scheme and Small industry Cluster Development Program.

The problems faced by the SMEs, particularly in accessing technology and maintaining competitiveness have been formidable. It has been found that sharing of information at local and national clusters are mostly informal. Information regarding the latest development and competency understanding is much less. Work sharing is not seen in the local and national clusters, as it is a fight for the same customer, in the same market. Even though the product and technology used by the entrepreneurs are similar, the tendency to share is less among the cluster participants.

The concept of cluster development offers new insights into the potential role of SMEs, in enhancing their access to new technology. Characteristics of a successful cluster are inter-firm cooperation, cooperation blended with competition, the importance of local value systems, flexibility and innovative capacity, geographic proximity, sectoral specialization, a local pool of skilled labour and the presence of a large number of firms. It also includes willingness to work together to resolve potential clashes of interest, widespread entrepreneurial spirit and ability, promotion of a social compromise.
SMEs find it difficult to match the wage rate, job security and career development opportunities, available in larger organizations and therefore are not in a position to hire skilled and competent manpower. Often, as a result a bottleneck develops in the SME organisation, it may result in just one or two people controlling the organisation, whether at the decision making level or at the operational level. Even in moderately large sized firms employing several hundred workers, these bottleneck points seem to exist. The decision-makers at the bottleneck points are obviously busy people. They must handle many day-to-day problems that demand immediate attention, e.g., payroll, inventory, finances, personnel, suppliers, and customer demands. These problems must be solved quickly, or the company will be unable to function. Clearly, there is little chance for them to think about making major changes or risk taking, which is essentially required for innovation process.

1.24.2 Financial Barriers

The non-availability of institutional finance on affordable and easy terms is hindering access to new technologies. In India the situation is further complicated by the fact that the preferred mode of finance is either self or other sources.

1.24.2.1 Some of the measures undertaken to improve the financial position of SMEs are:

Innovation in developing countries is promoted by venture capital, to help in indigenous development of technologies. In India financial institutions, such as Industrial Development Bank of India (IDBI), Industrial Credit and Investment Corporation of India (ICICI), Industrial Finance Corporation of India (IFCI), and other banks are providing financial assistance, for commercialization of indigenously developed technologies and adoption of imported technologies for wider domestic applications through venture capital.

Small Industry Development organization (SIDO) offers a number of financial services to SMEs. Some of its the popular schemes are Credit Linked Capital Subsidy Scheme for Technology Up-gradation, Credit Guarantee Scheme, ISO 9000 / IS 14001 Certification Reimbursement Scheme, Integrated Infrastructure Development Scheme, Cluster Development program, Mini Tool Room Scheme etc.[more details at www.smallindustryindia.com and www.laghu-udyog.com ]
In addition, recently Government of India has taken a number of initiatives to help small industries. Some of these initiatives are

i) **SED Bill**: The Small Enterprises Development (SED) Bill is on the anvil. Enactment of this Bill will remove the barrier to SSI growth, by inculcating a hassle free, user-friendly environment enabling SMEs to diversify from their conventional product range. It will, thus, encourage exports and global integration and propel SSI towards the projected 12 % targeted rate of growth.

ii) **Credit Rating Scheme**: The scheme has been introduced to encourage the SSI Units to get their credit rating done, by reputed third party credit rating agencies. The credit rating will facilitate hassle free flow of credit to SMEs, while enhancing the comfort-level of the lending banks. The rating will also bring out the strengths and weaknesses of the unit and provide opportunities to enhance their competitiveness. The rating will enhance the capability and credibility of the enterprise, to not only approach banks and financial institutions for capital and debt servicing on more favourable terms but also project its strength before buyers of its products. Government of India will reimburse 75% of the fees charged by the rating agency subject to a ceiling amount.

iii) **SME Fund**: Small Industries Development Bank of India (SIDBI) was set up in April, 1990 under an Act of Parliament. SIDBI is the principal financial institution for promoting, financing and development of industries in the small-scale sector. To further improve credit availability, a SME fund of $ 2 billion has been operational from the year 2004.

iv) **Credit Cards**: Laghu Udyami Credit Card (LUCC) Scheme (Small Entrepreneur’s Credit Card) has been liberalized. The credit limit has been enhanced from $4000 to $20,000 for borrowers who have a satisfactory track record.

v) Efforts are being continuously made to facilitate flow of institutional credit to SSIs on easy terms.

vi) **Some of the other initiatives taken are**

- Allocation of $87 million towards Technology Upgradation Fund for Textiles
Setting up of Knowledge Commission Institutions of Excellence at the cost of $20 million at the Indian Institute of Science, Bangalore

Weighted deduction of 150% of expenditure on in-house research and development facilities of companies, engaged in the business of biotechnology, pharmaceuticals, electronics, telecommunications, chemical, or any other notified products.

Custom duty exempted on capital goods and raw materials to a company for R&D project.

1.24.3 Technological Barriers

Technology is the key to enhancing a company's competitive advantage in today's dynamic information age. SMEs need to develop and implement a technology strategy in addition to financial, marketing and operational strategies, and adopt the one that helps integrate their operations with their environment, customers and suppliers. Ministry of SSI, Government of India, offers a number of technical services through its National Small Industries Corporation Ltd (NSIC) and Small Industry Development Organisation (SIDO).

1.24.3.1 Some of the measures undertaken by the Government to improve technological services:

National Small Industries Corporation Ltd (NSIC) was established 1955, by the Government of India to promote, aid and foster the growth of small scale industries in India. It offers a number of technical services to SMEs through its Technical Services Centres, Extension Centres, Software Technology Parks and Technology Transfer Centres. These include technology audits and benchmarking, technology needs assessment, technology sourcing and application of new techniques, technology acquisition, development of software, material testing facilities through accredited laboratories, product design common facility support in machining and tooling, energy and environment audit services Classroom and practical training for skill upgradation.

Besides these, Technology Business Incubation (TBI) is one of the most recent services, that NSIC has started. TBI enable technical entrepreneurs to conduct their R&D programmes in a professional, friendly and supportive environment, while
receiving the guidance and hand holding they need in the initial phase. This facility is being offered in Information Technology, Product Design, Energy and Environment auditing, Bio-Technology Electronics and Communications.

Small Industry Development Organisation (SIDO) established in 1954, provides a wide spectrum of technical services to the small industries sector. These include common facilities for testing, tool room services, technology up-gradation, modernisation, quality improvement, training for entrepreneurship development, a number of trainings for skill up-gradation, preparation of project and product profiles, technical and managerial consultancy, assistance for exports, pollution and energy audits.

Technology is the harbinger of change development; Developed nations spend substantial amounts on technology. It is believed that Japan spends not only on acquisition of technology but also spends seven times more on adoption of technology. Technology in conjunction with finance management, marketing capabilities is a powerful tool of economic development. Taiwan, which once had a productivity level equal to Indian SMEs, has now much enhanced it with the use of technology. In India, the technology used by SMEs ranges from primitive to sophisticated but so far, Indian SMEs have been predominantly preoccupied with finance and management issues.

India ranks quite high in possessing a large pool of organizations, scientists and engineers (There are 1200 technical institutions providing technical education to 0.38 million student every year) and a fully developed intellectual infrastructure, but is still is quite low in the matter of developing and adoption of new technologies in the SME sector. As technology is an important element, along with price and quality in determining competitiveness, many organizations are active in the area of offering technological assistance to SMEs, including the Council of Scientific Research (CSIR), Indian Institute of Technology (IIT), Technology Information Forecasting and Assessment Council (TIFAC), National Research and Development Corporation (NRDC), National Institute of Design (NID) Product and Process Development Centers (PPDCs), Mechanical Engineering Research and Development Organization (MERADO), National Small Industries Corporation’s (NSIC), and Asia Pacific Centre for Transfer of Technologies (APCTT).
But as stated earlier, the pace of technological transfer needs to be increased and linkages strengthened and streamlined for which efforts are underway to plug the gap. There are however, some success stories also, for example

i) Mechanical Engineering Research and Development Organization (MERADO), Ludhiana, was established in 1965 to nurture the growing industrial clusters in Ludhiana, in the field of knitwear, agro-industrial machine tools and bicycles industry. Since then, MERADO has contributed significantly towards design development and standardization of industrial machinery, agriculture machinery, machine tools, special purpose machines and consumer durables.

ii) National Small Industries Corporation (NSIC) has pioneered several schemes, for the growth and development of the small-scale sector. In the initial stages of development of the small-scale industries after independence, it was the innovative and novel schemes of the NSIC such as government purchase, hire purchase, development of prototypes and technical training, which led to the establishment of new enterprises, development of appropriate manufacturing technologies and creation of a strong first generation entrepreneurial base. These schemes of the Corporation acted as a catalyst for this sector. It has helped the small units in identification, adoption, absorption and transfer of technology.

At present, there are 2900 R&D institutions in India, of which 1350 are in the private sector. Out of these, over 1250 are in-house R&D units, employing over 45,000 scientific and technical personnel. However, the SME sector is largely aloof of such facilities. In the majority of the cases, the R&D outputs do not get commercialized for want of initial investment and the needed enabling environment and networking. In the recent past, the Department of Science and Technology, Government of India, has been focusing its attention on this aspect and has initiated a number of institutional based programmes. These include the mechanisms of Science & Technology Entrepreneurs Park (STEP) and the Technology Business Incubator (TBI).
The National Science and Technology Entrepreneurship Development Board of the Department of Science and Technology has played a pioneering as well as catalytic role in the Indian Business Incubation arena since 2000. So far 15 Technology Business Incubators have been set up at various institutions. In addition, there are 17 Science and Technology Entrepreneur's Parks and 50 other such organisation promoted across the country.

While most of the SMEs in developed countries have financial as well as technical capacity to identify technological sources and evaluate alternate technologies that would suit their requirements. Unfortunately, this capacity is missing in most of the Indian SMEs. It is this feature of our SMEs that makes them an ideal partner for technological upgradation, through technological cooperation with foreign enterprises.

1.25 SME capabilities for innovation

Dynamic capabilities are the specific knowledge and skills that firms learn in order to carry out specific activities, including formation of effective cross-functional teams and conducting an effective NPD process (Eisenhardt and Martin, 2000). They differ from “core competencies” (Prahalad and Hamel, 1990) in that they need not be rare or inimitable. For example, best practices in NPD can be learned and easily transferred between firms. Core competencies rely on leverage across NPD projects within a single firm for competitive advantage, but conditions may change too rapidly for this to happen. Instead, dynamic capabilities allow existing sets of knowledge and skills to be recombined and emergent requisite skills to be developed to meet new opportunities. The dynamic capabilities of particular concern are those that accelerate internal learning (e.g., degree of codification and learning routines) and networking capability (e.g., highly trained personnel who know what to look for and where). The choice of NPD projects feeds on itself to strengthen current dynamic capabilities or develop new ones (Branzei and Vertinsky, 2006). As part of a strategy to develop dynamic capabilities for NPD (e.g., technical, market, collaborative skills), SMEs need to carefully consider the types of NPD projects they undertake and the customers they serve (Mosey, 2005).
SMEs also vary in how much they focus on learning (Sahwu, 2005). Most SMEs don’t focus on learning, but even if they do, they vary in how much they codify their learning so that it can be used for developing similar products (Mosey, 2005). Many SMEs don’t recognize the value of data, have minimal archives and don’t learn from experience (Woodcock et al., 2000). Uncodified or tacit knowledge has benefits and shortcomings for SMEs. On the one hand, it is harder to identify what a firm is doing wrong if it has not codified its NPD process. Similarly, tacit knowledge plays a role in how SMEs learn from other firms. They are more influenced by being in direct contact with people (suppliers, customers) whom they know well and trust (Lindman, 2002). On the other hand, tacit knowledge is difficult to imitate so other firms cannot easily appropriate an SME’s intellectual property (Kogut and Zander, 1992).

SMEs have fewer employees, each with multiple roles (Yap et al., 2005), but they may be able to form cross-functional teams more easily than large enterprises because their professional specialization is less complete. Employees of SMEs interact more often with their counterparts and may have shared or swapped tasks with them. This gives team members a clearer idea of their respective contributions to the NPD process. The downside of less specialization is difficulty in keeping up with the latest knowledge in a given specialty. Assuming that senior management has a clear idea of what it wants its cross-functional teams to do, there is less risk of a disconnect between levels due to bureaucracy, delays, and miscommunication.

SMEs often carry out the new product development (NPD) process less completely or thoroughly than do larger companies (Woodcock et al., 2000). Most SMEs do not use all of the thirteen new product development “stage-gates” recommended by Cooper (1999). March-Chorda et al. (2002) found that 54% of Spanish firms use nine or less of Cooper’s recommended thirteen stage-gates. Huang et al. (2002) found that Australian SMEs undertook market-related activities less frequently than technical activities, and this distinguished successful from unsuccessful new products. Lindman (2002) suggests that SMEs that have close relationships with a limited number of customers may be able to forgo marketing steps because there is less need for market research. SMEs in the Finnish metal working industry (most with less than ten customers) do market research and learn...
about their customer's needs by working closely with them. SMEs with a formal written product development strategy are likely to complete more NPD stages with higher quality (Huang et al., 2002).

1.26 Innovation and Global Competitiveness

Innovation and competitiveness have a dynamic, mutual relationship. Innovation thrives in a competitive environment and in turn, plays a key role in the achievement of such an environment. Innovation generates economic value, new jobs in the economy and cultures of entrepreneurship. By virtue of its relationship with competitiveness, Innovation emerges as a factor in promoting economic growth. A recent World Bank study on Innovation notes that 'Innovation can be a critical driver of increased productivity and competitiveness and ultimately poverty alleviation ... Innovation is not an end in itself but a means to productivity growth and higher living standards.

Globalization provides opportunities as well as challenges for nations to use Innovation as a strategic lever to generate knowledge flows. It provides unprecedented potential for Innovation to be used as a tool for revenue generation, so that nations with a strong knowledge base, can once and for all, escape 'the stranglehold of poverty'. At the same time, globalization creates challenges for firms to either innovate or perish. 'In the race to the top slot, the only way ahead for companies is to innovate...the only way to stay ahead is to innovate.' As such, Innovation is the 'necessary core competence' to remain competitive in the new landscape.' In understanding the significance of Innovation, the possibilities offered by complex and interconnected global networks become relevant. The ability to 'adapt to changing market conditions and anticipate future technologies and economic trends' and leverage Innovation across a large number of markets provides 'opportunities for exploiting economies of scale as well as scope.' Innovation is therefore also emerging as a global activity 'dependent on international networks of knowledge sharing....requiring the combination of various disciplines.' In short, in this globalized landscape, comparative knowledge advantage and the availability of cutting edge Innovation at lower costs are becoming critical factors in the race to achieve economic competitiveness.
1.27 Country wise Innovation Culture

1.27.1 Sweden:

According to the Sweden study, they choose five companies to do survey and analyse the innovation culture. First, all the five companies pay attention to their innovation and they had done some innovation in the past. Some of them gave us successful examples in innovation. The Mats Engqvist who is product manager of KGC Verktyg & Maskiner AB Company answered them in the survey that they had done some innovation and some are successful, for example, New Business, New Offerings, New Ways of working, New Competence, New solutions, New or adapted IPR like Patents, “Trademarks”, “Copyrights” or even Academic Papers. And another company Syntronic said in its past innovation, it went through innovating new technology and new market got the profits. This is its success example.

Many factors will impact innovation. There are two kinds of factors, one is internal fact, and the other one is external factor. According to the survey, they conclude that the internal factors usually include the funds of the company, the technology support and the personnel allocation. The main external factors are competition and customers’ needs. In external factors, the customers’ needs are the most important factor. The company must according to the customers’ special demands to implement the innovation in order to satisfy the customers.

They have mentioned that the culture innovation is a process which embodies the enterprise values into enterprise culture and continue innovation and development according to its own characteristics, in order to make the development of enterprise match with the external environment. They also survey that what the five companies think the corporate culture innovation. The Syntronic answered that “it is important to learn and understand other cultures and use of equipment.” The KGC thinks the corporate culture innovation is necessary for its survival. Because you have to be open to new ideas, new solutions and new knowledge and so on. Another company Cargotec said “it is also important to corporate culture innovation. In sum, a technology innovation sometimes should go with culture innovation. An appropriate culture background could enhance the diffusion of new technology.” Whatever it is to understand the culture innovation, the companies all think that it is important for the innovation management.
The three main internal factors like funds of the company, technology support and personnel allocation will impact culture innovation. Among these, “The learning ability of innovation among personnel” is thought the most important one. They need to communicate with each other, and it is important for them to learn new things then they can create new things.

The external factors include challenge from the competitors, change of the external environment, the need of development of companies and others. Change of the external environment and the need of development of companies are essential. The companies all focus on it. Then the change of market demand will cause the demands of customers to change. For meet the customers’ needs, the companies should change their culture innovation. The external environment change means the market demand change. Only if they follow these changes, they can implement a right and suited innovation management to survival in the challenge environment.

1.27.2 Netherlands

According to the Netherlands survey results, it is clear that open innovation is also becoming increasingly popular among SMEs. This is not a surprising, considering the increasingly important role small and medium sized firms play in innovation. Small firms often lack resources to develop and commercialize new product in-house and as a result are more often inclined to collaborate with large, firms.

In addition, the survey results show that open innovation is not entirely different for services and manufacturing firms as they expected base on literature. Manufacturing firms are on average more active in the outsourcing of R&D and the out-licensing of IP, but they do not differ with service firms on other open innovation activities. This is an important finding; open innovation is as relevant for services firms as it is for manufacturing firms and research about open innovation should not be limited to SMEs that are involved in formal R&D activities. In contrast, they found significant differences between different SME-sizes

Finally, they identified several motives for firms to start open innovation practices and barriers that SMEs managers encounter when they open up their innovation process. Open innovation is mainly motivated by market-related targets:
these are the most important driver for firms to engage in venturing, to participate in other firms and to involve user in the innovation process. Most SMEs use a broad set of methods to meet the ever-changing customer demand and to stay competitive.

I.27.3 Irish

Irish study reveals that there is a lot of information on national systems of innovation, however, there is a paucity of studies on how SMEs can incorporate the principles and practices of innovation. Furthermore, there are few studies that use size classification within SMEs. Such an approach treats SMEs as a homogenous grouping and restricts studies to that of SME: large organization comparisons and contrasts. Based on the literature and the earlier exploratory research a conceptual model of innovation in SMEs has been developed and then applied in this study. The key area of within the model were Leadership, People and Culture, total Quality/Continuous Improvements, Product and Process, and Knowledge and Information and the overriding of the Market and Customers.

The first stage of model testing, investigating the effects of SME size in relation to innovation, has shown significant effects in a number of areas.

Regarding issues of Leadership this survey supports the findings of Cagliano et al (2001) that smaller SMEs are more operationally focussed and depend on more contingent and accidental factors, whereas the large SME focussed more on issues relating to strategic development.

In relation to people and culture within the organisation smaller SMEs experience more difficulties with communication, resources and providing a working environment that make the workforce more content. This supports the findings of Smith et al (2002) suggesting that the small firms focus on operational issues can have a detrimental effect on people development.

This section addressed issues of Total Quality/Continuous Improvement. This section elicited generally overall positive responses in terms of the positive benefits of the introduction of TQ/CI. Surprisingly the smaller SMEs reported that the positive effects of introducing TQ/CI in term of financial and business rewards were greater than for the larger SME.
The final section examined issues relating to the management of Knowledge and Information. As expected the larger SME had in place structures to support the storage and movement of information as well as clear divisions for the responsibility of managing that knowledge. This supports the findings of Mosey et al (2002) who suggest that the larger organization manager's knowledge and information are managed more systematically.

The finding of this survey highlights the differences in terms of how "innovation" is incorporated into SMEs from small (1-25) to large (200-250) companies. For policy makers and advisers who are responsible for the design of interventions to increase the innovative nature and competitive edge of the SME sector, it is vital that they take into account the range of practices and perception held by SMEs. This study has identified several important differences in terms of practices according to firm size that could potentially lessen the effectiveness of programmes or interventions introduced. One of the purposes of this survey was to examine the appropriateness of defining SMEs as one group with homogeneous practices. The survey sheds doubt on this approach, suggesting that a variety of interventions are necessary if advisers/policy makers intend to improve either innovative behaviour or competitiveness across all SMEs.
Reference


